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The Problem of Stage Lighting

IT is now seven years since the very instructive paper on " The Art of Stage Lighting " was read before the Illuminating Engineering Society by Mr. J. B. Fagan. On that occasion we had a very able exposition of the aims of stage lighting as conceived by one who is both an actor and a producer of plays. The paper by Mr. H. Lester Groom, which appears in this issue, treats the subject from the standpoint of the manufacturer of stage-lighting appliances. The paper, which was illustrated by a variety of exhibits of lighting implements and diagrams showing arrangements in modern theatres, contains a useful review of the appliances now at the command of the stage electrician. Besides the array of flood-lights, spotlights, battens, dimmers, etc., there is the " cyclorama," one of the most interesting developments of recent years which involves an artificial sky and horizon, and permits realistic reproductions of cloud-scenes and atmospheric effects. Other possibilities touched on by Mr. Groom included the use of coloured light in producing apparent transformations in dresses and scenery, the application of sources rich in ultra-violet light playing on dresses made of fluorescent material, and the projection of luminous scenery—the latter device described by Major Adrian Klein before the Illuminating Engineering Society last year. Special lighting units and striking spectacular effects, such as the imitation of flames and smoke and moving waves of the sea, were also shown by Mr. L. G. Applebee in the course of the discussion.

Anyone reading the paper and discussion must admit the skill and enterprise shown by manufacturers in this country in constantly adding to and improving the variety of stage-lighting appliances. The possibilities to-day are far greater than in the days of Sir Henry Irving and other great actors of the past, and one can only admire the ingenuity with which they contrived novel lighting effects with such relatively primitive appliances. Yet, great as are the advances made in this country, both manufacturers and producers of plays would do well to keep an eye on developments abroad, where lighting is coming to play an ever-increasing part in theatrical display.

Some of the discussion turned on the functions and aims of stage lighting, a matter which is the subject of constant discussion. If the different needs of various forms of plays and spectacle are considered the aims of lighting appear fairly clearly defined. Mr. Fagan, in his paper, placed lighting third in the list of requisites, the first being, naturally, the play, and the second the acting. In the case of certain productions it can truly be said that the action of the play itself is the dominant thing, and that the lighting is primarily intended to enable the audience to follow the play with ease. In such cases, as was remarked in the discussion, good stage lighting is essentially unobtrusive. It is the handmaid of the stage, enabling the actors and the scene to be studied, and should perform this service without calling attention to itself. In other dramatic performances, the appeal to the eye plays a more important part. The scenery, costumes, dances and special lighting effects may actually do more to make or mar the play than the acting. In the case of other entertainments it might be said that they are essentially " spectacles " rather than plays, and the appeal to the eye is the all-important thing. In these days the division between what used to be termed " legitimate drama " and variety entertainments and spectacles is less distinct. Advances in illuminants and lighting appliances have revolutionized ideas of stage-production. It is significant, as Mr. Groom pointed out, that the kinema theatre in turn is coming to make more use of stage-lighting devices in order to supplement the action of the film, or furnish interludes. A number of the latest kinema theatres have installed complete stage-lighting equipment, including the cyclorama, and interludes in which effects of coloured light play an important part are becoming more and more usual.

It would be difficult to find a field where there exist greater opportunities for the qualified illuminating engineer. The provision of lighting on the stage should be the subject of consultation between producer, actors, scenic artists and stage electrician. The latter, with his long experience, can afford valuable help, and often displays considerable ingenuity in obtaining striking effects with somewhat limited appliances. Further advances depend largely on the recognition by producers that the cost of lighting effects is more than compensated by increased public patronage. If the public is led to appreciate and demand the most modern and attractive methods of lighting, managers will be quick to respond. The " appeal to the eye," already often proves a determining factor in the success of a production.

In conclusion, we should like to endorse the appreciation expressed at the meeting of the hospitality of the E.L.M.A. Lighting Service Bureau. Their facilities for demonstrations and willing assistance proved specially useful on this occasion and contributed considerably to the interest of the meeting.

The Optical Convention

THE Optical Convention, which took place at the Imperial College of Science and Technology, South Kensington, during April 12th-17th, was an interesting event. It may be recalled that two previous conventions of a similar kind have been held, namely, those presided over by Sir Richard (then Dr.) Glazebrook, in 1905, and by Professor Silvanus P. Thompson in 1912. The Convention that has just terminated served to show that very considerable advances have been made in optics during the past 14 years. There was a most representative range of exhibits and a very complete and informative series of papers, and on this occasion efforts to interest the public by means of ingenious optical illusions and entertainments were on an unprecedented scale.

We consider the proceedings too important to be dealt with summarily in the present number. It is, therefore, our intention to devote our next number specially to a full account of the Convention, and for the moment we will content ourselves with a general reference to its main features.

Those responsible had taken a great deal of pains to render the Convention interesting and instructive. The President (Sir Frank Dyson, the Astronomer-Royal) was supported by a representative Executive Committee, whose Chairman, Mr. F. Twyman, F.R.S., is known to our readers as having been identified with much useful research work in optics, notably in connection with spectroscopy. Sir Arthur Paget, the Hon. Treasurer, was largely responsible for the Entertainments Section, which proved so popular, and to Mr. Thomas Martin, the Secretary, credit should be given for a great deal of hard preparatory work, and for the very successful efforts made to interest the press in the Convention. A useful step was the series of preliminary addresses on the aims and objects of the Convention given at the meeting of the Circle of Scientific, Technical and Trade Journalists on March 29th, which was followed by a special view of the entertainments on April 12th, and an opportunity for the press to examine the exhibits during the morning of the opening day.

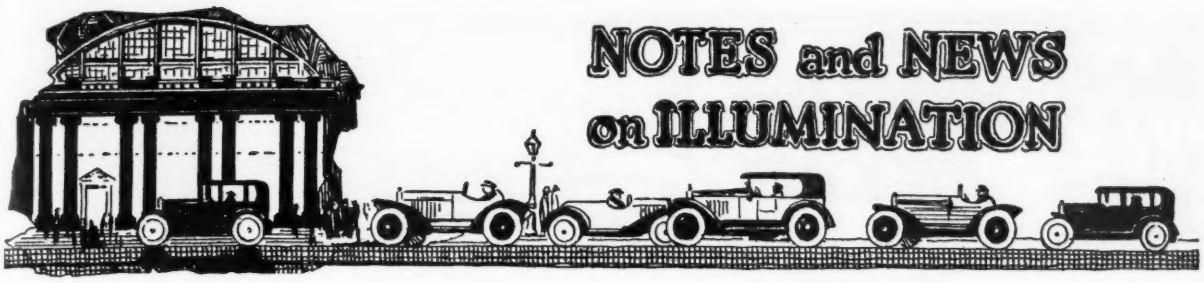
The Prime Minister, Mr. Stanley Baldwin, in his opening address on April 12th paid a well-merited tribute to the important rôle played by optical munitions during the war, and emphasized the necessity of the industry being placed on a firm footing in times of peace. The point emphasized in his remarks, as in the addresses at the meeting of the Circle mentioned above, was the great part played by optical instruments as avenues to knowledge. To the telescope we owe what knowledge we have of other worlds than ours, besides its many practical applications in navigation, exploration, and all fields where the observation of distant objects is necessary. The microscope, similarly, has rendered incalculable value services in the domain of medical knowledge and hygiene, and in metallurgy and many other fields of work it has been responsible for practical advances of great benefit to the human race. Turning to a somewhat less exalted application of optics, Mr. Baldwin also mentioned that the purity and quality of beer is dependent on exact tests undertaken with the polariscope.

Many other applications of optical instruments might be mentioned. Periscopes, range-finders, etc., serve as the eyes of warships. Optical signalling lamps and numerous other devices aid war operations on land. Surveying depends on the use of the theodolite and similar appliances. Again, what better illustration could one have of the services of optics than the camera-lens, which renders possible the recording of so many interesting incidents and scientific phenomena? And the numerous optical parts of the kinematograph, which ministers to the recreation of the public and is responsible for the creation of a vast new industry?

The Convention, however, was something more than a review of optical instruments. It was rather a survey of all practical applications of applied optics and manifestations of the use of light in the service of man. At every point one met instances of the close relations between optics and illuminating engineering, which formed the subject of a paper contributed by the writer. The exhibits in the Research Section included one by the Illuminating Engineering Society, where the special photometer used for testing flares during the war was shown, and records of the researches of the Society were presented. The series of demonstration boxes, illustrating various principles of illumination, kindly loaned for the Exhibition by the E.L.M.A. Lighting Service Bureau also proved of never-failing interest to visitors. But at neighbouring stalls one found at once many other exhibits of interest to illuminating engineers. The exhibit of results of tests of colour-fading by the British Research Association for the Woollen and Worsted Industries, the display by the National Physical Laboratory of methods of effecting precise measurements by the aid of light, the demonstrations of the spectra of artificial illuminants and spectrophotometers, the various other photometers on view, the exhibits of searchlight mirrors and dioptric lenses for lighthouses and aerial beacons, artificial daylight units, effects of invisible light—all these were exhibits falling within the direct scope of illuminating engineering.

Upwards of a hundred papers on the most varied subjects were read, and it may be estimated that at least half of these were of direct interest to illuminating engineers. The group of papers dealing mainly with photometry and researches on incandescent lamps presented on the morning of Tuesday, April 13th, and the afternoon of Thursday, April 15th, and the important series of communications dealing with various aspects of colour on the Wednesday (April 14th) may be singled out for special notice. We shall endeavour, in our next issue, to give a full account of the contents of these and other interesting papers.

Finally, a few words should be said about the ingenious optical illusions and entertainments, which proved such a popular attraction. Whilst one would not wish that such demonstrations should distract attention from the more serious side of the Convention, one recognizes that they serve a valuable purpose in attracting members of the public whose attention might not otherwise have been engaged. In the early days of science great experts did not disdain to lend their aid to such methods of impressing the imagination and arousing a desire to know how these wonders are performed. One might, therefore, perhaps suggest that on another occasion more efforts might be made to take the public into confidence and show "how the trick was done." Meantime the drawing power of these exhibits cannot be gainsaid. The ingenious "Fairies' Theatre," arranged by Dr. Clay, was an excellent object-lesson in methods of creating optical images, and the same applies to the "vanishing bank-note," and similar devices. Such conjuring tricks as "the lady who lost her head" could be used as a useful illustration of effects of contrast and glare deliberately produced to deceive the eye. To our mind, perhaps, the most effective of all these entertainments was the "talking films," surely one of the best possible illustrations of what modern science can accomplish.



A Review of School Lighting Requirements

The next item on the programme of the Illuminating Engineering Society is the discussion on School Lighting, to be opened by Dr. James Kerr at the meeting on April 29th. It is now 15 years since the subject was very fully dealt with before the Society in 1911, though it has been frequently referred to in subsequent discussions. The immediate result of the meeting in 1911 was the formation of a joint committee, of which Dr. Kerr was Chairman, and which reported in 1913. During the subsequent 15 years our ideas of modern requirements in school lighting have altered somewhat. There have been considerable advances in lamps and fittings, rendering possible better lighting conditions than in the past. The moment is, therefore, opportune to review progress and initiate further investigations. The forthcoming meeting is being held after we go to press with this issue, but the proceedings will appear in our pages in due course.

The Lighting of Arteries of Traffic

One still observes not infrequently references to certain streets as being inadequately lighted. This applies particularly to "arterial thoroughfares," such as many routes running across the Thames to the south and south-west of London. The Great West Road in Middlesex is also said to be insufficiently lighted, and the considerable number of accidents has been ascribed to this cause—though it may also be that its width and good surface tempt motorists to excessive speeds. It must, however, be recognized that the development of motor traffic has set new standards in lighting.

The Departure of the Airship "Norge"

Illumination gave Amundsen's airship "Norge," in which he is attempting to fly across the North Pole from Spitzbergen to Alaska, a dramatic send-off this month. After the airship had been brought out from her shed, she hovered a few feet from the earth. Then the searchlights caught her and the vessel was vividly outlined against the dark blue sky, bathed in white light, and became a gigantic silver fish. As she moved away from the aerodrome the searchlights held her captive, the silver light which illuminated it showing up sharply every detail. Very gradually the "Norge" went off, and the light on it became weaker. The silver became a soft grey, and then one saw only the name "Norge" standing out. A few seconds later even this had gone. The vessel simply faded out.

Further E.L.M.A. Activities

Reference is made elsewhere to the enterprising departure being made by the E.L.M.A. Lighting Service Bureau in establishing the first "Illumination Course" for women, the subject being appropriately "The Lighting of the Home,"—women's special sphere. We go to press before the course takes place (April 29th and 30th), but we wish the effort every success. We may take this opportunity of mentioning that a commencement has been made towards the formation of yet another local bureau, namely, in the Midland area. At a luncheon recently arranged at the Queen's Hotel, Birmingham, Mr. J. Y. Fletcher presided. Following addresses by Mr. C. W. Sulley and Mr. W. E. Bush, a resolution in favour of the establishment of the Bureau was passed with acclamation.

Gas and Electricity Thrive Together

The Gas World draws attention to the experience of the St. Helens Corporation, as showing that gas and electricity undertakings can both prosper in friendly competition. In 1923 the St. Helens Corporation electricity undertaking ranked fourth in Great Britain in regard to low cost of production; the following year it was third, and in 1925 second. It now occupies the premier position in Lancashire in this respect for municipally-owned power stations. In 1914 four million units were sold; in 1925, 32 millions. Surely substantial progress!

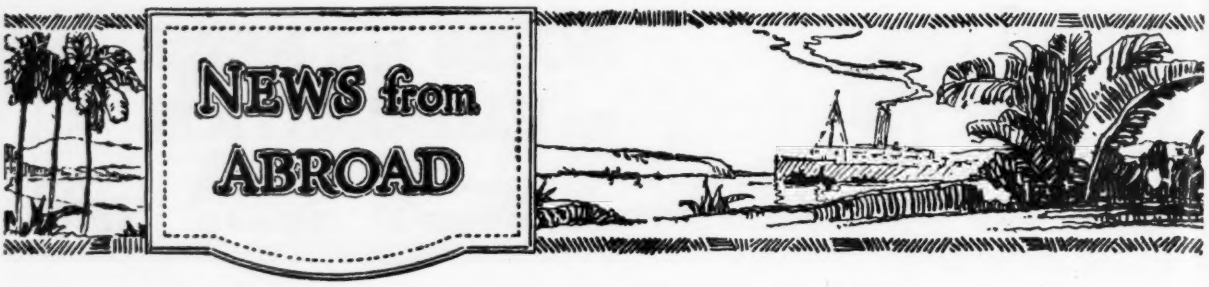
Nevertheless, simultaneously with the Electricity Department, the Gas Department has made good progress. Its output in 1914 was 555,162,000 cubic feet of gas; in 1925, 743,480,000. The rapid increase in output of electricity is understandable, as the undertaking was in its initial stages in 1914. But, as our contemporary remarks, "the figures show that, under the most stressful competition, gas and electricity can thrive together, provided that the respective undertakings are guided by the requisite degree of technical ability."

Similar conditions exist in Bournemouth. The Bournemouth and Poole Electricity Co. is flourishing. But Mr. William Cash, the Chairman of the Bournemouth Gas and Water Co., in presiding at the recent annual meeting, remarked that this concern was also doing well. In 1924 the gas sales increased by nearly 10 per cent., and in 1925 by nearly 8 per cent., and arrangements have been made to meet further increased demands for gas. In short, there is room in Bournemouth for both companies.

Obituary

MR. WILLIAM RANSOM COOPER.

We record with great regret the death of Mr. W. R. Cooper, which occurred on March 15th, 1926. About two years ago he suffered from a nervous breakdown, and it is doubtful if he ever recovered completely. Mr. Cooper was identified with many researches of an electrical and physical nature, and took a sympathetic interest in illuminating engineering. He acted for some time as the Editor of *Science Abstracts*, and occupied the editorial chair of *The Electrician* during 1906 to 1919. He served on the Council of the Institution of Electrical Engineers, and was a Vice-President of the Faraday Society and Hon. Treasurer of the Physical Society. He was the author of a standard book on primary batteries, on which he was a recognized authority. During the war he did much useful work on the Nitrogen Products Committee of the Ministries of Inventions Department, and it is probable that the strain of war work contributed to the breakdown which led to his death at the age of only 58 years. Besides wide scientific knowledge, Mr. Cooper had considerable literary gifts, and all those who came in contact with him were impressed by his courteous and kindly unassuming manner. His death will be regretted by many close friends in the electrical industry and in the scientific world.



A "Lamp-Museum" in Czechoslovakia

We have just received a description of a novel feature in the Czechoslovak Technical Museum at Prague, which could not readily be paralleled elsewhere—the exhibit of electric lamps built up during the past three years. Lamps in all varieties from 1870 onwards are shown. They are so arranged that any lamp can be lighted up, or the filament allowed to show a red glow, so that its shape can be clearly seen. The exhibit is divided into seven main sections, which have been extended to include arc lamps, vapour lamps, etc. There is also a collection of lamp-holders. The exhibit is not yet complete, and additions are constantly being made to keep it up to date. We are particularly interested to observe that the erection of a section dealing with illumination is in prospect. We hope to publish a fuller account of this museum, together with illustrations, very shortly.

The Lighting of a Diamond Mine

Searching for diamonds differs in many respects from mining for metals, notably in the fact that the material really worth examining is usually confined in a well-defined "pipe." Thus, in the Premier Mine in the Transvaal the mine consists of an oval pipe, roughly half a mile long and a quarter of a mile wide. This whole area has been slowly dug away, and the result has been a pit, which has now reached a depth of 500 feet. The walls are of rock, and constant blasting is necessary to render the material accessible for examination. It has been found that the mine is much more profitable if it can be operated continuously for the whole 24 hours, but the problem of providing artificial light for night work proved somewhat difficult. Originally lighting with arc lamps was introduced, but the constant blasting proved very destructive to the lamps and wiring. Ultimately the South African General Electric Company has introduced a method of lighting by huge search-lights mounted in batteries on the brim of the pit and enabling unceasing operations to be conducted. It was in the Premier Mine that the celebrated Cullinan diamond, weighing over 3,000 carats, or roughly 1⅓ pounds, was found.

The Renaissance of the Lighting Art in France

Under this title *L'Electricien* summarizes the impressions of Mr. G. A. Atherton, an illuminating engineer in the United States, following his visit to the Exhibition of Decorative Arts in Paris. The chief impression recorded is that of the extreme originality in the design of many of the objects exhibited, which extended to lighting devices. Many of these were highly ingenious and clever, almost all were new. Another feature is the completeness with which the different professions in France have adapted illumination to their respective traditions and needs. Architects, for instance, have developed their own ideas on lighting, instead of leaving this matter to others. They have made illumination an integral part of their works, arranging for niches to receive sources of light, apertures and alcoves, recesses under cornices, etc. Almost invariably the lighting arrangements had been studied at an early stage in the design, not adopted as an after-thought, with the result that the lamps and fittings harmonize with the general decorative scheme in a remarkable way. Similarly the idea of embodying the lamp in the design of furniture has been developed. Lamps are mounted as an adjunct to couches so as to be themselves shielded from view, but illuminate a rest on which books can be placed. In bathrooms lamps are as completely concealed as the wiring; light, like water, is available everywhere it is needed, without the source being seen.

Decorators have been infected with the same enthusiasm for utilizing light, even in the smallest vases and other objects. A wall has been built up of dark bricks. Illumination for reading purposes is provided by several portable lamps, but the general illumination is furnished by a number of lamps concealed in recesses amongst the brickwork, which also serve for ventilating purposes, and the removal of tobacco smoke. Another pleasing device is the framing of a mirror with a border of frosted glass. Lamps equipped with reflectors are placed behind the mirror. Thus anyone using the mirror receives light from the sides, and the conditions of illumination are excellent.

A third impression derived from the Exhibition was the variety of materials that can be used in distributing light. Alabaster materials in many forms, glass pearls and cylinders, clear and tinted crystals and varieties of glass of novel colouration and design are utilized.

The exterior lighting did not arouse so much interest. Outlining of buildings with rows of lamps was general. But attention was drawn to the novel colour-scheme at the entrance to the Exhibition, the pillars and walls being decorated in a strange red-purple and illuminated by neon lamps, whilst the adjacent plants and verdure receive light from mercury-vapour lamps, making an effective contrast.

Electric Incandescent Lamps in the United States

According to information received, the sales of ordinary electric incandescent lamps are estimated to reach 280 million for the year 1925. This is an increase of 7½ per cent. over the figure for 1924, and 4⅓ times the number in 1908. The average wattage of lamps during the period 1908-1925 has varied little, but the average lumens per candle-power has increased greatly, so that the total output of light is now 16½ times as great as in 1908. About 105 million miniature lamps were sold, an increase of 3½ per cent. as compared with the previous year. Amongst recent developments interest attaches to the double-filament lamp for automobile headlights, which contains two 21 candle-power filaments. This arrangement, as previously noted in this journal, renders possible the substitution, when approaching other cars, of a depressed beam, which is much less glaring than the full driving beam.

Hints on Interior Lighting

We have been favoured with a copy of a recent lecture by Dr. Paul Heyck, of Messrs. Körting and Mathiesen, now reprinted. This contains some useful hints on illumination, aided by numerous effective illustrations. After explaining the importance of avoiding glare and inconvenient shadows, practical examples are given. Thus a series of photographs shows the difference in appearance of a bust of a man's head or a carved capitol, illuminated by light coming from different directions. Other pictures show the unsightly shadows on ceilings and walls produced by using bowls or concentrating reflectors in the wrong way. There are also numerous photographs of lighting installations, good and bad examples side by side. The lecture illustrates the keen interest taken in principles of illumination in Germany.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

A Discussion on Stage Lighting

(Proceedings of the meeting of the Illuminating Engineering Society, held at the E.L.M.A. Lighting Service Bureau, 15, Savoy Street, London, W.C., on Tuesday, March 30th, 1926.)

A MEETING of the Illuminating Engineering Society was held, by kind invitation of the E.L.M.A., at the Lighting Service Bureau (15, Savoy Street, London, W.C.), at 7 p.m. on Tuesday, March 30th, 1926, Mr. J. W. T. Walsh presiding.

The minutes of the last meeting having been read, the Hon. Secretary read out the names of the following applicants for membership:—

Aves, O. .....Consulting Ophthalmic Optician, 126, Fillbrook Road, Leytonstone, E.11.

Clifford, F. D.....Electrical Engineer, Messrs. Philips Lamps Ltd., 145, Charing Cross Road, London, W.C.2.

Dixon, D.....Consulting Engineer, 10, Will Street, Jewin Street, Aldersgate, London, E.C.

Blunden, W. T. E.....General Sales Manager, Messrs. Philips Lamps Ltd., 145, Charing Cross Road, London.

Harris, H. D. .....London Sales Manager, Messrs. Philips Lamps Ltd., 145, Charing Cross Road, London, W.C.2.

Mann, A. B. .....Electrical Engineer, H.M. Office of Works, Engineering Division, Caxton House, Westminster, S.W.1.

The names of applicants announced at the last meeting* were read again, and these gentlemen were formally declared members of the Society.

The Chairman then called upon Mr. H. LESTER GROOM to open the discussion by his paper on "Stage Lighting," which was as follows:—

Stage Lighting

By H. LESTER GROOM

INTRODUCTION.

The art of stage lighting, as far as this country is concerned, is one which seems to have received far less serious consideration than it really deserves. Even to-day, in spite of the notable work which has been done abroad, more especially in Germany, it appears to be a subject which is generally treated more as a necessary and unavoidable evil than as, perhaps, the most important and vital adjunct to the play itself. Light on the stage—and in this paper I propose to deal only with the standard type of stage in its present-day form—is not only necessary in order to permit the spectator to follow the action of the play, but it is also a medium through which certain mental effects may be created. It has ceased to be a mere illuminant serving to light the actors and scenery, and is gradually assuming a greater and more important rôle.

In this connection I would like to quote two passages from Kenneth MacGowan's book on "Continental Stage Craft."

In a chapter* dealing with "Light as Setting" he says: "Light itself seems destined to assume a larger and larger part in the drama. It is a playing force, quite as much as the actors. It can be a motivator of action as well as an illuminator of it," and again, after describing the rôle of light in the scene of Macbeth's death in André's production of the opera, he writes: "Such a scene suggests wide possibilities. Light as the compelling force of a play; light as a motivator of action; light and setting not as a background to action, but as part of it, as something making characters exist and act; light as an almost physical aura of human bodies—light therefore in conflict." Here we have an admission of the great and important rôle which light may be made to play on the stage quite distinct from its original and primary function as an illuminant.

The conception, however, of the utilization of light in this vastly extended sphere is one which for its successful realization will depend on the willingness of the producer and the artist to accept this potent and flexible medium as a vehicle for the expression of their ideas.

A considerable amount of work in this field has already been carried out abroad, chiefly I believe in Germany, and it would seem that interest in this subject is now being slowly but surely awakened in this country.

The point I would emphasize is that the means are available and awaiting exploitation, but their successful utilization will require something more than a blind confidence in the stage electrician to produce lighting miracles on demand.

The producer will have to acquire, in addition to his own particular technique, a sound working knowledge of the fundamental and elementary principles of light and colour before he can hope to apply them efficiently to the problems he must face in order to use lighting as "the compelling force of a play," not merely in the rôle of a simple illuminant, but as a vital medium through which he may express his imagination and individuality in the interpretation of the drama.

GENERAL PRINCIPLES.

Stage lighting embodies many of the principles of correct illumination. For example, we do not see glaring scources of light on the stage, as not only would they distract attention but they would also fatigue the eye and cause general irritation to the spectator.

Sources of light such as footlights, battens, floods, etc., are carefully concealed, and whenever it may be necessary to provide a lighting fixture, such as an electrolier, in a given setting, this is merely rendered sufficiently luminous to fulfil its apparent function, and the actual lighting of the scene is obtained from other sources.

* *Illuminating Engineer*, March, 1926, p. 69.

* Chapter VI.

The aim of stage lighting is to provide light of any intensity, hue and tint, just where and when it may be required. To achieve this result we must have, firstly, an adequate equipment of apparatus capable of providing the required lighting effects, and, secondly, complete control over this apparatus.

The general requirements of stage lighting are met by the provision of equipment which has been standardized, and varies only in details of design modified to suit individual cases. This equipment in its main essentials consists of footlights, battens or border lights, wing floods and spotlights of various descriptions. In addition, provision must be made for the control of this apparatus by means of a main switchboard working in conjunction with dimmers and their control gear.

Apart from this standard equipment, which is common to all stages, various other special apparatus is used for effect work generally. For instance, special projectors with motor-driven "optical effects" are coming into general use, and in America especially I believe they are largely employed in productions of the spectacular type.

By far the most important development of recent years has been the effort to obtain, as nearly as possible, the representation of realistic and natural atmospheric effects on the stage.

The means which have been devised for this purpose consist in the use of an artificial sky or cyclorama. For lighting the cyclorama a battery of specially designed floods fitted with glass colour screens is used. A cloud apparatus and a set of three panorama projectors complete the equipment.

Cycloramas are extensively used abroad and consist of two types: (a) a solid "sky dome" consisting of a plaster surface supported by a metal framework; (b) a movable canvas "artificial horizon" cloth running on a curved rail, which can be rolled up out of the way when not required.

Owing to the improvements which have been made in the design of the latter, resulting in the production of a cloth which hangs without creases or ripples when in use, resulting in a perfectly smooth background from which light can be reflected evenly and without shadows, the canvas type of cyclorama is rapidly superseding the plaster dome.

The introduction of cycloramas as a standard part of stage equipment involves some radical modifications in the lighting of the acting area itself, as obviously the greatest care must be taken to prevent the light from battens, flood-lights, etc., from striking the canvas, for the consequent mixture would ruin the colour effects. Special floods called acting area flood-lights are usually employed for lighting the acting area, and the footlights dimmed down sufficiently to avoid interference with the lighting of the cyclorama.

The practice of using powerful arcs from the back of the upper circle for spotting individual performers seems to me a bad one, as the spectacle of patches of intense light falling on individual performers destroys the general lighting balance, and the visible beams are a source of irritation to the spectators in the upper portion of the house.

A certain amount of lighting from the front of the house is, however, necessary, and we find this is obtained by using flood-projectors of the colour magazine type designed to flood the whole of the proscenium opening, thereby obtaining the necessary frontal illumination.

I am referring above only to the lighting of ordinary theatre stages, and the problem is somewhat different when we consider the variety stage, where a number of turns are given by single performers. In this case the individual is the centre of attraction, and the general practice in this country seems to favour the concentration of the greatest amount of light from every available source on to the performer, the background and setting being a matter of unimportance.

When considering the lighting of variety stages we have to remember that the performance consists of a large number of distinct turns each requiring a fresh setting. This necessitates a great number of drop scenes occupying the whole stage from front to back. Very little space is available for overhead lighting equipment, and the use of the cyclorama seems out of the question. Standard equipment consists of a number of border lights, footlights, wing floods and perch spotlights. In addition several spotlights are placed in the auditorium for frontal illumination.

Regarding the important question of dimmers and dimmer control, modern practice favours the metallic type with either hand or remote control regulators. Metallic dimmers fall under two main classes, i.e., the closed plate type and the open metallic type; both have their advantages and disadvantages, but it seems clear that the metallic type will be universally used in future, entirely superseding the liquid dimmer which has been used to a great extent in the past.

An essential feature to my mind is the provision of a special lighting bridge placed behind and just above the top of the proscenium opening. This bridge is used for effect projectors, special spotlights, floods, etc., and forms a most important part of the general stage lighting scheme. It is invaluable when a cyclorama is used, as the illumination of the acting area can be materially assisted by lighting apparatus placed on this bridge.

The control of the whole of the stage lighting should be, as far as possible, from one central position, the switchgear and dimmer regulator being placed together in an operating room commanding a good view of the stage in order to enable the electrician to observe his lighting effects. Far too little attention seems to be paid to the provision of an adequate size operating switchroom. This is usually far too small and the result is a confined area crammed with apparatus, leaving the minimum possible amount of working space for the operator and his assistants. Not only is this unsound from the point of view of efficiency in operation but difficulties arise when the question of installing additional apparatus, with its attendant control gear, has to be considered.

Stage Equipment.—I now propose to consider the various types of apparatus required for the equipment of a full-sized stage. They may be classified under the following headings:—

(1) Footlights
(2) Battens or Border Lights and Proscenium Strip Lights
(3) Flood-lights
(4) Spotlights
(5) Portable Effect Apparatus
(6) Cyclorama Lighting and the Cyclorama
(7) Dimmers and Dimmer Control Regulators.

Footlights.—Footlights give a strong general illumination from the stage level, serving to intensify the facial expression. In themselves they tend to reverse natural shadows, but this defect is counteracted by the downward illumination from the battens.

There are three main types of footlights:—

(a) Trough type
(b) Magazine type
(c) Combined Direct-indirect type.

The trough type consists of a sheet-metal trough, fitted with holders spaced evenly apart. The interior is either painted white or equipped with a polished metal reflector. This type is not particularly efficient, and its main merit lies in cheapness. As far as modern stages are concerned, it is practically obsolete, but still serves a useful purpose for small stages, concert platforms, etc., where the question of expense is a consideration.

The magazine or compartment type is now standard practice, and consists of a series of compartments, each fitted with a lampholder and reflector. The reflectors may be of highly polished aluminium, silvered glass, or, in the latest type, rustless and non-tarnishing steel. Colour-slide holders are provided in front of the compartments, and provision made for a protecting metal wire guard. The lamps are spaced at 6 in. to 7½ in. centres, and sizes up to 150 watts can be used.

Three or four colour circuits are usually required. The wiring is carried in a separate channel at the back of the fitting, and means of easy access to it are pro-

vided in the design. Colour mediums of gelatine or glass may be used, but if of glass they should consist of small separate strips to allow for expansion due to heat.

Adequate ventilation is of importance, and is provided by rows of holes carefully baffled to avoid leakage of light.

The direct-indirect type is comparatively new, and has been principally used abroad up to the present. As its name implies, it can throw either direct or indirect light on the stage, as required. It consists of separate sections of 100-watt tubular gasfilled type lamps mounted on a hinged framework, which can be rotated through an angle of 180°.

When indirect lighting is required the banks are swung down below stage level, and their light directed on to a curved metal reflector, which in turn directs the light on to the stage. The reflector is hinged, and by adjusting the angle of tilt the direction of the reflected light can be changed.

The sections are made up in metre lengths, each comprising ten lamps spaced approximately 4 in. apart. The lamps are placed in compartments fitted with polished metal reflectors. Semi-circular glass colour mediums with a matt surface are used, giving a soft, evenly diffused light covering a wide area. This footlight is usually wired for five-colour circuits., i.e., white, yellow, red, blue, and green, and as the type of lamp used enables the distance between centres to be considerably reduced, as compared with the magazine type, the gap between lamps of a given colour is appreciably diminished. This footlight is admirably suited for use in conjunction with cyclorama lighting.

The disadvantage lies in the greater amount of space required in comparison with the magazine type, and the cost is somewhat greater.

Footlights may be divided into two, or even three, sections, so that individual sections only may be used, but this, of course, means an increase in the number of circuits brought back to the board, and adds to the expense. They should not extend the entire width of the proscenium opening, but should be made four or five feet shorter.

Battens and Proscenium Strip.—Battens are used for the general illumination of the stage. They are suspended from the grid by flexible steel lines running over pulleys and operated by hand winches to allow for adjustment to the desired level, and for lowering to the stage for cleaning, renewal of lamps, etc. The spacing allowed is usually from 6 ft. to 8 ft. apart under normal conditions. They may be divided into two general types—trough and magazine—but the latter is now standard.

The design of the magazine batten follows the same lines as the magazine-type footlight with some slight modifications. The lengths should be sufficiently strong to prevent any chance of buckling and provision must be made for taking the suspension lines. The outer shell of the batten should be as free as possible from projections which might catch in the scene drops, and a small but important point is the provision of springs in the colour-slide runners to hold the colour mediums firmly in position.

Battens are wired for three or four-colour circuits, and lamps of 100 to 150-watt size are generally required.

The reflectors are similar to those used in footlights, but in this instance I think the metal reflector is preferable to the silvered-glass type, owing to the risk of breakage under working conditions and the possibility of damage caused by broken glass. This remark applies equally to glass colour mediums.

In some cases very powerful battens are employed, and units fitted with 1,000-watt gasfilled lamps have been used, notably in the United States, where they are installed at the New York Hippodrome.* The present tendency is towards battens equipped with higher wattage lamps, partly due to the increasing number of colour circuits, which naturally reduces the number of lamps for a given colour, and also on account of a general demand for more powerful illumination, particularly in the case of the variety stage.

Battens should, generally speaking, be made about two feet longer than the width of the proscenium opening; this length, however, must be modified when a cyclorama is used, owing to the curve of the cloth.

Proscenium borders or strip are similar in design to battens. They are mounted in lengths placed vertically on each side of the proscenium opening, and serve to provide a certain amount of side lighting. They are practically out of date under modern stage conditions, and are being replaced by spotlights and floods.

Flood-lights.—Flood-lights are used for providing powerful illumination over the surface of the acting area, and can be divided into two general classes:—

(1) Acting area floods for providing downward illumination.

(2) Wing and perch floods for side illumination.

Acting area floods are particularly useful for lighting the acting area when the cyclorama is in use, as the light is reflected downwards at a comparatively steep angle, in order to avoid the sky-cloth; thus the stage is flooded naturally without interfering with the lighting effects on the "artificial sky."

These floods are made in three standard sizes to take 300-watt, 500/1,000-watt and 1,500-watt gasfilled lamps respectively. The reflectors are highly polished aluminium spinnings, which do not appear to tarnish or dull appreciably in use.

The lamps can be adjusted to their correct position relatively to the reflectors by means of a small hand-wheel and spindle mechanically connected to the lamp-holder. The bottom of the fitting contains a hinged holder carrying a glass diffusing or colour medium protected by a guard. The glass is made up in narrow strips to prevent risk of breakage owing to heat, and strips can be easily replaced when necessary. For special purposes these floods are equipped with colour magazines containing red, yellow, green, and blue glass colour slides, which are operated by tracker wires led over pulleys to a counter-weight four-lever control gear placed in the switchroom.

FIG. 1.—1,000-watt Stage Flood, with Colour-slide Magazine, for mechanical remote control.

They have certain disadvantages which prevent their adoption for use in place of battens. These are as follows:—

(1) The fitting must be fixed rigidly in position, as any movement would slacken or strain the tracker wires and affect the operation of the colour slides.

* Page 19, "Stage Lighting," by A. L. Powell and Theodore Fuchs; Bulletin L.D., 146A, G.E.C. of America.

(2) As the flood must be rigidly fixed, it follows that the source of illumination is at a constant height, whereas battens can be easily raised or lowered at will to meet the lighting requirements of a particular set.

(3) The multiplicity of tracker wires which run back to the control position—perhaps 60/100 ft. away.

(4) The fittings are large and bulky, and would probably be damaged by swinging drop scenes.

In spite of these disadvantages, this fitting has a distinct field of use—especially for small stages where the number of drop scenes is limited and the entire acting area is employed to its fullest extent. In this case, a four-colour, or, including white, a five-colour system of illumination is available from a single powerful source.

An installation of this kind would under these particular circumstances possibly work out cheaper than battens owing to the elimination of the extra wiring and switch-gear for controlling the separate colour circuits.

Wing floods are portable units mounted on heavy base telescopic stands, and are made in sizes ranging from 300 to 1,500 watts. They are required for providing strong additional illumination to given areas on the stage, and can be moved to any required point, as desired.

Flexible leads to the nearest stage plug supply the necessary current, and dimming is often effected by a slider-type resistance fixed on the stand. They must be strongly constructed and well ventilated.

Grooves are provided for colour mediums, which should preferably be of gelatine, which can be handled more easily and rapidly than glass, and is, moreover, safer to use under the conditions.

Perch floods are similar in construction to wing floods, and their function is the same. They are, however, used from fixed positions.

Spotlights.—It is sometimes necessary to vividly illuminate a small area either to bring a portion of the scene into special prominence or to direct attention to an individual. This is effected by means of spotlights. Spotlights give a strong concentrated beam of light which can, however, be changed into a flood, if required, by placing a diffusing screen in front of the condenser lens.

They are made in sizes ranging from the "Baby" Spot, taking a 100-watt lamp up to the big stage spotlight projectors designed for use with 1,500/3,000-watt

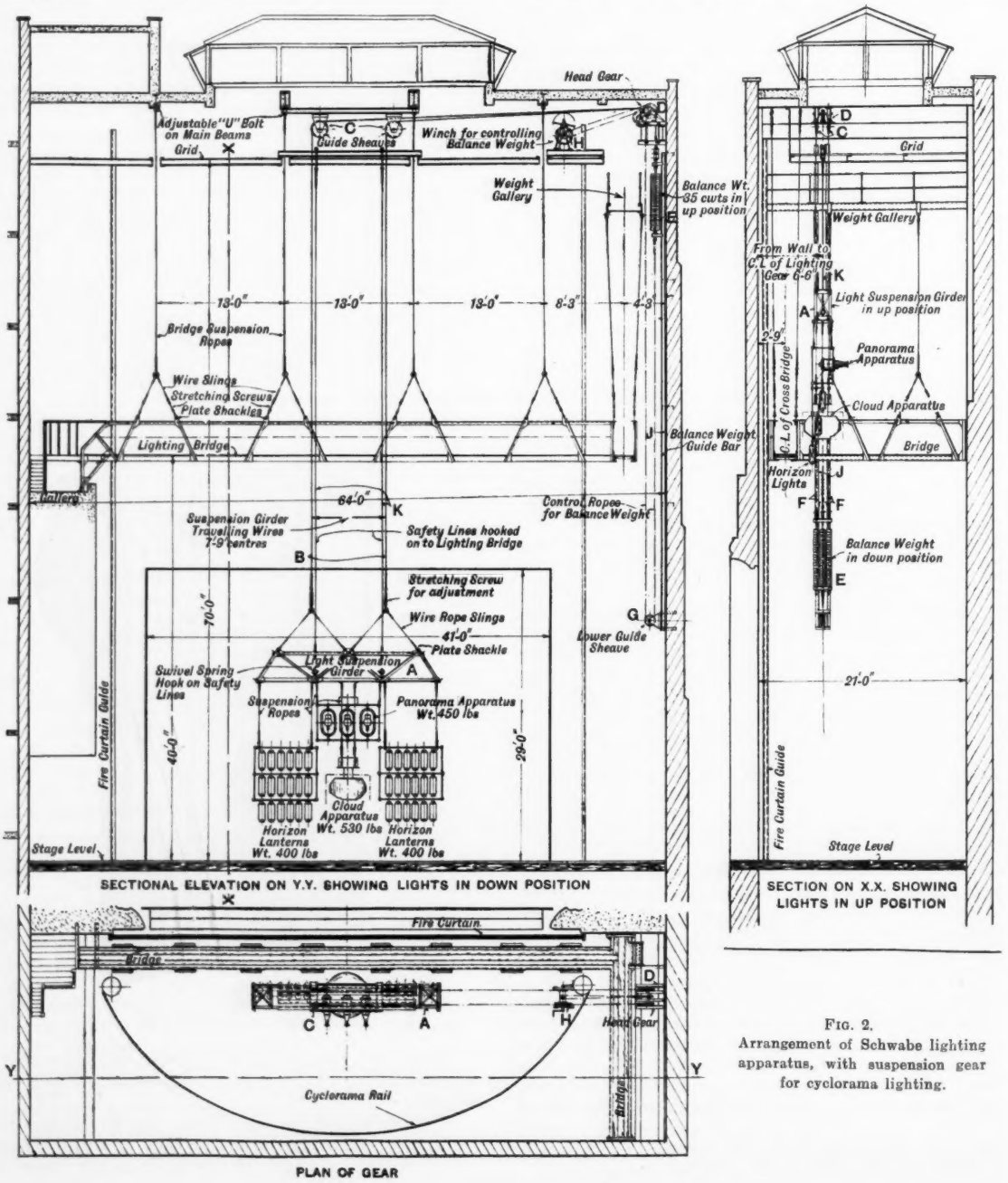


FIG. 2.
Arrangement of Schwabe lighting apparatus, with suspension gear for cyclorama lighting.

projector-type lamps. They may be used either from the wings, perches, or on pipe mountings placed each side of the proscenium arch. A special type of powerful spotlight is made for use from the lighting bridge, and is designed for projecting a beam vertically downward. The lamp used is made for burning at any angle, and has a specially supported filament.

Batteries of medium-sized spotlights are frequently placed just above the proscenium arch, and are set to cover the particular areas requiring special illumination. The gasfilled lamp is rapidly superseding the arc for spotlights used on the stage itself, but for front of house work, where the length of throw is over 70 to 80 feet, arc lamps are undoubtedly superior owing to the considerably greater intensity of illumination obtainable with them and the ease with which a small beam can be projected over a considerable distance owing to the virtual "point" source of light obtained from the arc.

Portable Effect Apparatus.—Effect projectors are used for projecting pictures or moving effects on to a suitable background. They are fitted with projection lenses, and can be either of the arc or gasfilled projector lamp type.

"Effects" such as rain, snow, fire, etc., consist essentially of painted mica discs, fixed in a suitable housing and driven by a clockwork motor. The range of available effects covers a very wide field, and very interesting results may be obtained by using a number of these projectors simultaneously, to obtain some particular combination.

A special development in this field is the use of the ultra-violet rays of the arc. These have the property of making objects fluoresce when painted with certain chemicals. An ordinary arc may be employed for this purpose, but in this case 100 to 120 amperes are required for good results.

A special filter is used which cuts out all visible rays, allowing the ultra-violet to pass. By treating costumes with these chemicals some startling changes may be effected on a darkened stage, and very beautiful colour effects may also be obtained.

Cyclorama Lighting and the Cyclorama.—The cyclorama, or artificial sky, is used very extensively abroad—especially in Germany, where this form of lighting has been most carefully studied.

In its modern form it consists of a number of sheets of canvas sewn together, and painted with a white composition forming a smooth surface. The cloth, when in use, hangs without creases or folds, and as it can be rolled away to one side when not required it is a far more practical proposition than the plaster dome, which is a cumbrous fixture.

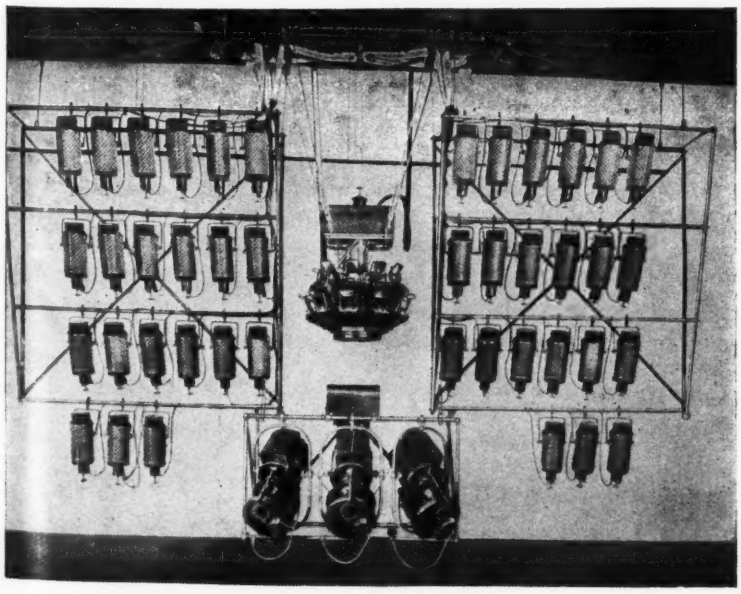


FIG. 3.—Schwabe Apparatus at St. Martin's Theatre showing Horizon Lamps, Cloud Apparatus and Panorama Apparatus.

The use of the cyclorama for obtaining a natural sky background to the stage setting eliminates the necessity for painted sky drop scenes of any description.

The illumination of the cyclorama is effected by a battery of "horizon floods" fitted with special tubular-type 1,000-watt gasfilled lamps; semi-cylindrical matted glass colour filters are used, giving a spread of light covering 180°.

Seven colours are used, i.e., four shades of blue, ranging from daylight to violet-blue, red, yellow and green. By blending these colours in the correct proportions, practically any colour tones may be produced.

The numbers of floods required will naturally vary according to the size of the stage. Taking an example of a medium-sized theatre, about 42 horizon floods will be required, forming the complete battery. The arrangement of coloured elements requires careful consideration in order that the cyclorama may be evenly lighted with any combination of colours desired. As a matter of interest, I may mention that the schedule of colours for a battery of this size is as follows: For deep dark blue there are nine elements and three different circuits; for middle blue and light blue (light and dark azure), also nine elements and three circuits in each case; for green, six elements on two circuits; there are also three daylight, three yellow and three red units, each on a single circuit—making a total load of 42 kw.

The Schwabe cloud apparatus serves for producing a series of colour-pictures of travelling clouds, which are projected on to the horizon, whereas the panorama projection apparatus may project auxiliary clouds, and, what is more important, landscapes on to the artificial horizon. In both cases 3,000-watt projectors are used (three for the panorama and one for the cloud apparatus), and a fuller description of the apparatus will be given at the meeting.

The full equipment for a stage of this description requires a total load of 54 kw.—quite apart from the main lighting of the stage. In very small theatres the panorama apparatus is not necessary, and a smaller cloud apparatus, taking a 1,000-watt projector, may be used. The load for the horizon-flood battery will also be much less. Taking the complete range of conditions, from a small theatre to a large opera-house, the load for the horizon flood-battery, panorama and cloud apparatus might vary from about 20 kw. up to 100 kw.

Dimmers and Dimmer Control Regulators.—The successful working of a stage-lighting system depends to a great extent on the dimmers and their control gear, and the importance of the selection of a suitable type of dimmer cannot be over-emphasized. The choice lies mainly between the embedded plate type dimmer with combined regulating gear and the open type metallic dimmer with tracker wire control. In the latter case the dimmers are housed in a separate chamber, and the control gear is in the operating room. Personally, although the cost is somewhat higher, I prefer the open type, because it is extremely reliable, and slight repairs or adjustments can be made with the minimum of trouble. A considerable number of these dimmers are in use in this country, and require practically no attention beyond occasional adjustment of the tracker wires.

Colour on the Stage.—The consideration of the part played by coloured light on the stage would require a separate paper. In particular, the effect of coloured light falling on coloured objects may be studied. Thus, if we have a red object on a white background, and illuminate it by red light, there will be no contrast or difference in brightness, and the object will be invisible. Similarly green light falling on a green object on a white background will cause the object to fade out. Hence, if a picture

(For continuation see p. 116.)

National Illumination Committee of Great Britain

Chairman's Report for the year 1925, presented at the Special Annual Meeting of the Committee on Thursday, the 28th January, 1926

THE past year has witnessed the passing of four of those who have built up international reputations in connection with illumination and its related sciences. The Committee wishes to record its sense of loss occasioned by the deaths of Mr. Charles H. Wordingham, Professor André Broca, Professor Otto Lummer, and Dr. Hugo Krüss.

In consequence of the establishment of the Sectional Committee on Illumination, mentioned in last year's Report, the increasing work of the National Committee relating to problems of standardization and kindred matters has largely been taken over by the Sectional Committee on Illumination of the British Engineering Standards Association, of which the National Illumination Committee has formed the nucleus. This latter Committee, moreover, has representatives on all the sub-committees which have so far been formed to deal with specific standardization problems.

The National Committee still deals as hitherto with all international matters, and it is felt that the broader outlook created by the bringing together of the various technical and industrial interests on the sub-committees is making it possible for the National Committee to approach matters of international interest with considerably more confidence and authority than in the past.

The sub-committees of the Sectional Committee of the British Engineering Standards Association on Illumination which have already been set up are given below, together with the names of the representatives of the National Committee thereon:—

Sub-Committee 39/1.—*Portable Photometers:* Mr. Clark, Lieut.-Col. Edgcumbe (Chairman), Mr. Harrison, Professor MacGregor Morris and Mr. Walsh.

Sub-Committee 39/2.—*Nomenclature and Symbols:* Lieut.-Col. Edgcumbe (Chairman), Mr. Good and Mr. Walsh.

Sub-Committee 39/3.—*Diffusing Glassware:* Mr. Buckley, Lieut.-Col. Edgcumbe, Mr. Gaster, Mr. Harrison and Mr. Walsh (Chairman).

Sub-Committee 39/4.—*Industrial Reflectors:* Mr. Buckley, Lieut.-Col. Edgcumbe, Mr. Gaster and Mr. Harrison (Chairman).

Sub-Committee 39/5.—*Street Lighting:* Lieut.-Col. Edgcumbe, Mr. Gaster, Mr. Harrison, Mr. Paterson (Chairman) and Mr. Walsh.

Sub-Committee 39/7.—*Photometric Integrators:* Mr. Buckley, Lieut.-Col. Edgcumbe, Professor MacGregor Morris and Mr. Walsh (Chairman).

The Sub-Committee on Portable Photometers has completed a specification which has been issued as B.S.S. No. 230—1925.

The Sub-Committee on Nomenclature and Symbols was able to be of assistance to the British Engineering Standards Association in preparing the Illumination Section of the forthcoming glossary of electrical engineering terms. As a result, a British Standard Glossary of Terms used in Illumination and Photometry has been issued separately as B.S.S. No. 233—1925.

The Sub-Committee on Diffusing Glassware is making very satisfactory progress, and it is anticipated that a specification will be agreed upon in the near future.

The Sub-Committee on Industrial Reflectors has so far confined its attention to one type of reflector, and as a result has issued a specification for an industrial reflector for direct general lighting, as B.S.S. No. 232—1926. The Sub-Committee is now considering the possibility of standardizing a reflector of a somewhat more concentrating type.

The Sub-Committee on Street Lighting, in spite of the obvious difficulties of the problem, is making good progress with a draft specification for various types of urban street lighting.

The Sub-Committee on Photometric Integrators, although appointed early in the year, was only able to commence work towards the end of the year.

Preparation for the meeting of the International Commission on Illumination, which is to take place next year in New York, will necessitate considerable activity by the National Committee during the coming year. In view of the importance of the work it is hoped that the constituent societies will do all in their power to assist the Committee in sending a thoroughly representative British delegation, so that it may take an effective part in the deliberations of the session.

K. EDGCUMBE,

Chairman.

28th January, 1926.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

The Lighting of Mirrors

(Communication from the E.L.M.A. Lighting Service Bureau.)

THOUGH it may appear a trivial item in the long list of work performed by the illuminating engineer, the lighting of mirrors is none the less a problem worthy of consideration. In these days when much attention is paid to personal appearance, a mirror is an important article of furniture. Its value, however, depends not only on its own quality, but also upon the arrangement of lighting to which it is subjected. The

FIG. 1.—Illumination at Dressing-table Mirror by two shielded lights.

object to be reflected should be well and evenly lighted, while as little light as possible should fall directly on the mirror. Another point of great importance is that glare must be reduced to a minimum.

It is a common experience in private homes to find that none of these conditions are observed. Frequently the bedroom is lighted by one central electric lamp, so that anyone using the mirror on the dressing-table is "in his own light." Instead of falling on his face, the light falls on the back of his head, while more often than not he is dazzled by a reflection of the lamp itself in the mirror.

An improvement on this arrangement is sometimes provided by a "rise and fall" pendant placed over the dressing-table. Even this, however, is by no means satisfactory, since it throws light on to the top of the head, but leaves parts of the face, such as the eyes, the upper lip, and the throat in shadow. To overcome these faults a device may be employed such as that illustrated in Fig. 1. Here are shown two bracket-lamps fitted on either side of the mirror. The lamps used are of medium wattage, and are either shielded from the eye by means of a translucent shade of silk, parchment or diffusing glass, or else, if bare, have white bulbs. This ensures a light of low intrinsic brilliancy which sufficiently illuminates the face without dazzling the eyes. Moreover, it is free from the annoyance of specular reflection, and under such conditions it is possible to perform toilet operations in comfort and to the best advantage. There is yet a further advantage in this particular system due to the fact that, should it be desirable to move the dressing-table to some other part of the room, the convenience of the lighting is equally good, and does not necessitate alteration in the wiring of the lighting points.

Fig. 2 shows a similar method of lighting a bathroom mirror. Here a good light is essential for the purpose of shaving. Every crease and curve in the face must be lighted, while the chin and throat are especially important. The frequent occurrence of steam in the bathroom renders silk or other fabric shades unsuitable. Globes of diffusing glass might be used, though simple white lamps would serve the purpose quite well. In neither of the cases just mentioned should the intrinsic

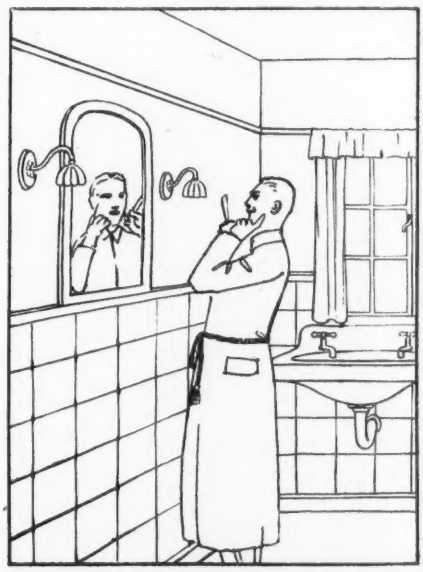


FIG. 2.—Illustrating importance of good Illumination to a Person Shaving.

brilliancy of the light source be greater than three or four candles per square inch.

The last illustration, Fig. 3, shows a method of lighting multiple mirrors, such as those used by tailors and dressmakers in their fitting-rooms. It will be seen that one lighting point is placed towards the sides of the

Osr

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DECORA
LIGHT

BLACKPOOL BY NIGHT.
Photographs showing the application of colour lighting at BLACKPOOL.

Local authorities have prov
decorative lighting is employe
ings, promenades, piers, ba
gardens, etc., the greater the
MORE LIGHT increases loca
local residents and shopkeepe
enjoyment of visitors.

The use of OSRAM Colour-spray
the troublesome process of re-v
frequently necessary with the ol
lamps. The colours are absolu
are unaffected by the severest

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PRAYED LAMPS
for
TDOOR
RATIVE
HTING

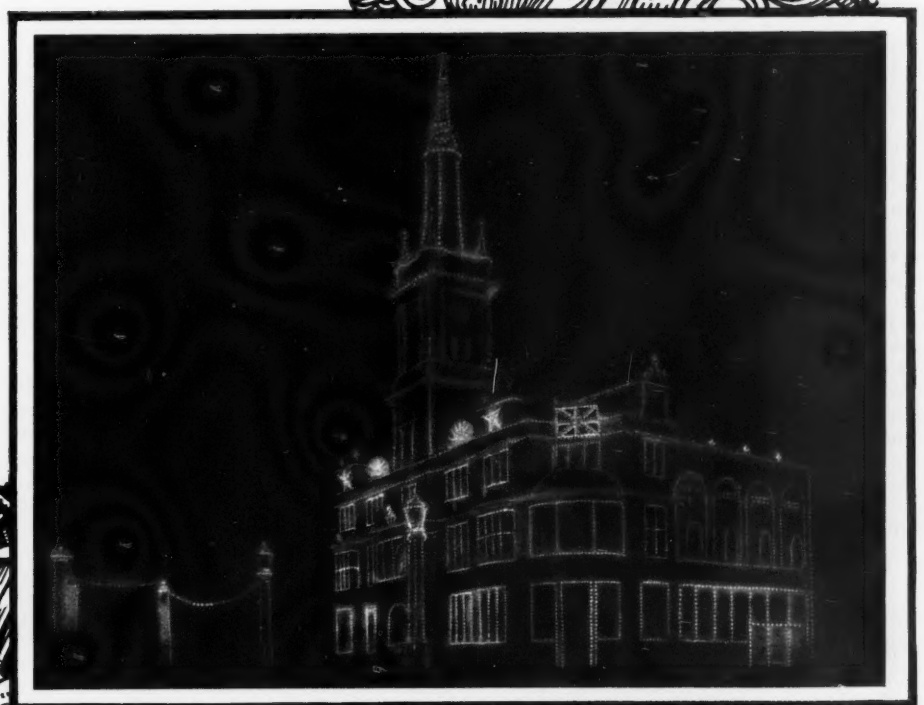
BLACKPOOL BY NIGHT.
Tens of thousands of OSRAM Colour-sprayed Lamps are in use at this popular resort.

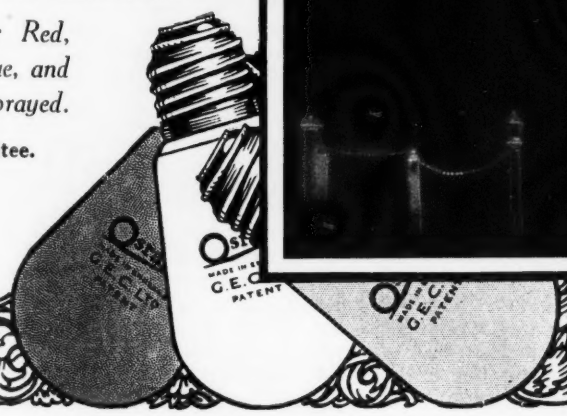
s have proved that the more g is employed for public build-s, piers, bandstands, pleasure greater the influx of visitors. ncreases local revenue, benefits d shopkeepers and adds to the itors.

l Colour-sprayed Lamps eliminates rocess of re-varnishing which was y with the old gelatine varnished rs are absolutely permanent and the severest weather conditions.

RD COLOURS: Red, ellow, Green, Blue, and . Also White Sprayed.

E.C.—Your Guarantee.





central mirror for the purpose of lighting the front of the customer. On top of each of the other mirrors is placed another lighting point for illuminating the customer

FIG. 3.—Illustrating the Lighting of Multiple Mirrors in Dressmaking Establishments.

equally on both sides. As in the previous cases, the light must be diffused by means of glass or fabric shades. Should the fitting-room be a cubicle with mirrors against three of the walls, strip-lighting might also be placed vertically down the edges of the side mirrors most distant from the centre.

Whichever method is adopted, the customer will be evenly lighted on all sides, and in consequence will be able to gain a clear idea of the work he is inspecting, while the tailor will find his task greatly simplified.

Better Lighting in Mines

The lighting of mines, which formed the subject of a recent discussion before the Illuminating Engineering Society, was also touched upon in several recent papers before the Institution of Electrical Engineers. It is estimated that labour accounts for 75 per cent. of the cost of producing coal; therefore, any improvement, such as better lighting, which renders easier work possible should be very welcome. Mr. Sam Mayor pointed out the possibilities of flood-lighting where intensive mining is practised and large outputs are got from comparatively short faces. In such circumstances general lighting at the face, without reference to individual workers, is often possible. On conveyor faces men are grouped in considerable numbers, and the light from the ordinary hand lamp is quite inadequate. Improved lighting is not only conducive to greater output, but favourable to safety. In open-lamp pits where alternating current cables are used there is no difficulty. The 25 candle-power lamps (with frosted bulbs) are protected by suitable fittings and operate at 25 volts from small transformers, connections being made by flexible conductors with sockets at intervals of 12 feet. The work of Professor W. M. Thornton has gone far towards showing that similar methods may now be safely employed, even in most "closed-lamp" pits.

Personal

Readers will note on another page (page 124) an announcement of changes in the Directorship of Messrs. Siemens and English Electric Lamp Co. Ltd. Mr. S. H. Callow, the Sales Manager of the Company, has been appointed a Director. Readers will join with us in congratulating Mr. Callow on this well-merited recognition of the good work he has done for the Company. Mr. Callow's name is also familiar to readers as a member of the Council of the Illuminating Engineering Society, in whose proceedings he has taken an active interest ever since the earliest stages of the Society.

E.L.M.A. Illumination Courses

THE eighth series of lectures on Illumination was held at the Lighting Service Bureau from March 23rd to 26th, being attended by representatives of electric supply undertakings. Seventy signatures were recorded, representing thirty-three undertakings from all parts of the United Kingdom.

The lectures were greatly appreciated by all present, as evidenced by the interesting and instructive discussions which followed. The list before us includes 21 lectures dealing with varied subjects, such as "Lighting Fundamentals and Principles of Distribution" (Mr. W. J. Jones); "Economies of Light Production" (Mr. F. J. Hawkins); "Planning a Factory Scheme" (Mr. H. Lingard); "Office Lighting" (Mr. C. A. Hughes); "Light and the Central Station" (Mr. J. L. H. Cooper); "Possibilities of Colour Lighting" (Mr. L. E. Buckell); "Lighting of the Home" (Miss F. G. Hodge), etc.

A Group of those participating in the Course.

The course concluded with an informal dinner at Carr's Restaurant, the chair being taken by Mr. C. W. Sully. This function served to cement the friendships which had sprung up during the course. Hopes were entertained that those present would have the opportunity of attending similar courses in the future, and the data and information which had been received would do much to assist the propagation of better standards of illumination.

We have also received particulars of another interesting departure, the Home Lighting Course for Women, arranged for April 29th and 30th. In view of the large number of women now employed in electrical showrooms throughout the country, and the great possibilities for their services in the field of illuminating engineering, the course should prove useful. The series of six lectures takes the audience by easy stages through the history of lighting, illustrating the demands of modern civilization, and then explains, by the aid of numerous demonstrations, how the home should be wired and lighted. As usual, the course is wound up by an informal dinner. These notes are necessarily written before the course has taken place, but we hope in our next issue to be able to report that it was as successful as others held under the auspices of the E.L.M.A. Lighting Service Bureau.

The Importance of Shadow in Lighting

The Evening News, in commenting on the scientific wonderland at the Optical Convention, remarks that it dealt not with optical instruments only, but with light itself. "There is one exhibit as simple as possible, but extraordinarily fascinating. It is the bust, in some white material, of a man wearing a cowl. Electric lights with breaking currents cast on it illumination from various directions and of varying strength. As the lights, and the shadows they carry, fall here and there, the features of the hooded man quicken with conflicting emotions. It is a proof of how much of the beauty and nobility of the human face depends on the play of light."

This description will be recognized by some of our readers as applying to one of the series of booths, illustrating various principles in lighting, which were kindly lent by the E.L.M.A. Lighting Service Bureau for the occasion, and formed part of the Illuminating Engineering Society's exhibit.

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Click!

At twilight to-night—click!—and millions of Mazdas will instantly go on duty, giving fine lighting service

ELECTRIC LAMPS

B T-H

Can be bought wherever electric lamps are sold.

Clear Fused Quartz and Metal Gallium used in High Temperature Thermometer

A THERMOMETER similar in appearance to the usual mercury-in-glass one but capable of registering a temperature of more than 1,800° Fahr. has been developed in the Thomson Research Laboratory of the General Electric Company of America at Lynn, Mass., U.S.A. Instead of glass, which would melt at far lower temperatures, the thermometer bulb and stem are made of clear, fused quartz; and instead of mercury, which would boil and cause the thermometer to explode at such a temperature, gallium, one of the rarer metals, is used.

A temperature of 1,000° Fahr. is the maximum with the mercury-in-glass thermometer, and such thermometers are inaccurate at high temperatures. By the use of mercury-in-quartz, German scientists attained a previously maximum temperature of about 1,300° Fahr.

The ordinary household thermometer has a vacuum in the stem above the mercury, and the usual high-temperature instrument uses gas under pressure in the stem. The new gallium thermometer returns to the first principle, with a vacuum or only slight amount of gas above the registering column.

The development of a method for the commercial production of clear fused quartz as tubing was the first development in the Thomson Research Laboratory that made the new instruments possible. The other necessary study was in regard to the physical and chemical properties of the rare metal gallium.

This metal is similar to mercury in appearance, but is much lighter in weight. It melts at a temperature of 100° Fahr., but can be cooled to about 40° before solidifying. Gallium boils at about 3,600°, so that it is not necessary to have it under pressure in the thermometer.

In making the thermometers, it is necessary to have the gallium very pure, since slight traces of certain impurities so affect the metal that it sticks to or "wets" either glass or quartz. "Wetting" makes a metal unsuitable for use, in thermometers. It was therefore necessary for the scientists to investigate the properties of the metal before a process could be developed whereby the pure gallium could be obtained within the stem of the thermometer.

Even further research was necessary, however, since it is not possible to etch and mark quartz in the way that glass is handled in thermometer manufacture. It was found that cold hydrofluoric acid, used for glass, attacks the entire quartz surface in spite of protective coatings. The etching was accomplished by using hot dilute hydrofluoric acid, with polymerized chinawood oil as a protective coating. To make the etching easily visible, a composition of sand and copper oxide was used to produce grayish-black marks; this substance not only withstands the intense heat but also resists most chemical reagents.

Such devices as thermocouples, pyrometers and similar devices have been needed previously for high temperature readings. The new thermometer permits accurate high-temperature determinations in the usual manner.

One advantage of the use of quartz for thermometers is its low coefficient of expansion. Thus quartz is not affected by sudden changes of temperature which would shatter glass.

Gallium-in-quartz thermometers are the latest of a number of instruments made possible by clear fused quartz. Other recent developments have included quartz motion-picture lenses, a large variety of medical and surgical instruments, quartz paning for windows for medical studies, and improved astronomical mirrors.

Gallium was discovered in 1876 by Lecoq de Boisbaudran. During the following four or five years considerable experimental investigations were carried on by him and others, but in the following period of forty years little work was done with the element.

In the United States a source of gallium was discovered ten years ago in the "leady residues" left after the distillation of zinc from certain ore. Residues obtained from such ores in the Missouri and Oklahoma regions contain considerable gallium, but since there were no commercial uses for the metal, these residues were not worked for their gallium content. Instead, they were sold for their lead value.

The application of gallium in a cadmium lamp for monochromatic light has been reported but seemingly has not been commercialized. At present, gallium cannot be obtained in quantities on the market, but the use of the metal for thermometers will probably make such production possible.

The Best Lighted Rural Highway

Apparently the Staten Island highway, used extensively for the night-delivery of farm products into New York, can claim to be the best lighted rural highway in the United States. The Hylan boulevard, which runs across the island is of concrete and 50 feet wide, with 10ft. sidewalks on each side. General Electric Novealux highway units, consisting of nested parabolic reflectors and equipped with 250 c.p., 6 amp. lamps, are used. The first installation included 119 units but 400 have since been installed on the island. The lights are mounted 32 ft. 6 in. above the road surface. On the Hyland boulevard there are 166 lumens per running foot of road, an increase of 100 per cent over the original installation. It is believed that there is no other rural highway in the United States with so high an illumination.

"Sunlight" at the Zoo

Under this title "Modern Sunlight" gives an account of a visit recently made to the Zoological Gardens, where interesting experiments with ultra-violet light are now being made. In the experimental monkey house, for example, three metal-filament quartz glass lamps have been installed near the roof. The monkeys clearly appreciate the light and warmth provided, almost invariably climbing to a shelf near the lamps as soon as they are turned on. In general the monkeys show much greater activity and enjoy better health than those in the old-fashioned houses where access of ultra-violet light has not yet been provided. In the case of the marmosets the effect is particularly striking. It is stated that under the old conditions these creatures would rarely live more than a few weeks. Those in the new cage have been there about seven months; without the warmth, sunlight and air, probably none of them would be alive to-day. Another feature of the new monkey house is the roof of "Vita-glass," which allows the beneficial part of the ultra violet rays in sunlight to be transmitted; thus not only is "artificial sunlight" provided, but the full value of such natural sunlight as is available is secured. It is stated that the caves of the Monkey Hill are also lighted by quartz lamps and heated by electrical radiators.

In the new lion house something like 4,000 square feet of Vita-glass are being provided. In the reptile house, which has been equipped with quartz lamps, iguanas, which in the past never survived an English winter, are being kept in health. It is stated that during the week before the lights were turned on three out of the twenty iguanas had died; since the light was installed there has not been a single death. In the case of these South American lizards conditions of light comparable with those they enjoy in their native place appear to be an absolute necessity.

It is understood that, in view of these favourable experiences, plans are being developed for the provision of artificial sunlight on a much greater scale at the Zoo.

Stage Lighting

IN view of the paper by Mr. H. Lester Groom, which appears in this number, attention may be drawn to a useful bulletin ("Stage Lighting," by A. L. Powell and Theodore Fuchs), which forms one of the "Lighting Data" series issued by the Edison Lamp Works of the General Electric Company (U.S.A.). In the opening pages there are several reproductions of scenes on the stage, showing how artificial light may be applied to produce certain effects. One of these is the court-room scene from "The Devil's Disciple." There is a brief historical review of stage lighting from the days of the Greeks and Romans onwards. In 1628 a German manual described the arrangement of candles and oil lamps in the position of present-day footlights, and also in grooves behind the sides and top of the proscenium opening. Theatre managers have often proved so anxious to improve productions that they introduced new developments in lighting on the stage before they found general acceptance for ordinary purposes. Illuminating gas was introduced at the Lyceum Theatre as early as 1803. The opera house in Philadelphia was the first in America to use this new illuminant. Gas had then to be manufactured on the premises, and huge mains, control tables, etc., were necessary. Some of the mains exceeded 12 inches in diameter.

Most modern stage-lighting methods date from the introduction of electric incandescent lamps. The authors discuss in detail choice of apparatus. White paint, as a reflecting surface, has the property of giving splendid diffusion and soft shadows. But it requires frequent renewal. Mirrored glass and polished metal are necessary wherever accurate control or concentration of light is desired. The usual forms of footlights, border-lights, etc., and the cyclorama are next described, likewise the production of rainbows, clouds, etc., by means of the sciopticon and "effect-machines." Familiar dodges, such as the imitation of log-fires by shapes of papier-maché, with silk streamers blown upwards by a fan to simulate flames, are mentioned. After discussing the switchboard and wiring problems, some hints for amateur productions are given. In conclusion, there is a discussion of the use of coloured light, especially in connection with the production of transformations and illusions.

The bulletin is concluded by a useful bibliography on stage lighting, which is reproduced herewith.

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The New Metro-Vick Showrooms

ATTENTION has been drawn in this journal to the tendency of leading electrical firms to move westwards. During recent years we have had, for instance, the installation of the General Electric Co. Ltd. at Magnet House, Kingsway, and of the British Thomson-Houston Co. Ltd. at Newman Street (Oxford Street). Equally interesting has been the transformation of Charing Cross Road, which has become an important arterial thoroughfare and the home of a number of leading electrical concerns. We mentioned in our last issue the transference of Philips Lamps Ltd. to this thoroughfare. We have now to record the opening of Metro-Vick House at 145, Charing Cross Road, in a convenient position about 100 yards from the junction with Oxford Street.

On Monday, April 19th, there was a very representative gathering of technical journalists in response to the invitation from Messrs. Metro-Vick Supplies Ltd. to visit these new premises. Those present were afterwards entertained to luncheon at Frascati's Restaurant, when Sir Phillip Nash, K.C.M.G., presided. In the course of an address reviewing progress in electrical developments, Sir Phillip paid a tribute to the ability of the press, for whom Mr. L. Gaster (Editor of *The Illuminating Engineer*) responded.

To these imposing new premises the whole of the London Office and Erection Staff of the Metropolitan-Vickers Electrical Co. Ltd. and the Head Office and London Office of the Metro-Vick Supplies Ltd. have been transferred. The headquarters and various other departments will, however, remain at 4, Central Buildings, Westminster. These new premises are on the site formerly occupied by Messrs. Crosse & Blackwell's factory. They contain excellent storage accommodation, express lifts to elaborate trade counters, and extensive showrooms fully equipped for the demonstration of domestic appliances and lighting fittings. There are also a wireless demonstration showroom, a writing-room with stenographic service for the use of trade customers, and ground-floor windows fitted with the most modern arrangements for shop-window lighting and display. Contractors, by previous arrangement with the illuminating engineering department of the company, can here stage demonstrations for the benefit of customers and themselves.

A feature of the offices is their design for maximum access of light—offices being placed round the front and sides of the building and the centre devoted to stores. Special attention has been paid to the lighting of windows on street level, which have been designed to illustrate the latest advances in shop-window lighting. The main showroom, with its variety of fittings and fine central showcase, is decorated in finished style, and mention may be made of the beautiful walnut panelling of the William and Mary period in the entrance hall.

We understand that the whole of the wiring and lighting arrangements were carried out by Messrs. Engineering Works (Electrical and General) Ltd., under the supervision of the illumina ing engineering department of Metro-Vick Supplies Ltd. It is hoped that this new development will prove of assistance to the contracting trade, and we may add that Messrs. Metro-Vick Supplies Ltd. are wholesale only, and that the facilities they have provided are for their trade customers.

The Lighting of Badminton Courts

When a discussion on "The Lighting for Games and Sports" took place before the Illuminating Engineering Society in 1921 some reference was made to the lighting of badminton courts. Artificial lighting here is of special importance, because badminton is habitually played indoors, and is one of the few active games that can be conveniently played in a relatively small space by night. One of the guiding principles emphasized at the meeting in 1921 was that overhead bright lights must be avoided. In the case of badminton, players are continually looking directly upwards, and any bright light seen in close proximity to the shuttlecock must have a disturbing effect. The great speed of the game as now played is another circumstance that renders very careful lighting desirable. When witnessing the recent All-England Championship at the Royal Horticultural Hall the writer observed that overhead lights were dispensed with, the illumination being provided by rows of gasfilled lamps with opal or white-sprayed bulbs, placed between the courts. This arrangement no doubt diminishes the liability of glare. Nevertheless there must be circumstances in which the view, even of these side-lights, interferes with strokes. One received the impression that the ideal method would be one rendering it impossible for any player to see direct light from the source, even if screened by an opal bulb. It is conceivable that better conditions might be secured by the illumination from concealed lamps of extensive inclined white surfaces between courts, placed at a height sufficient not to interfere with the view of the audience, and themselves serving as sources of moderate brilliancy. As the area of the badminton court is relatively small, the greater consumption of energy by this method would probably not prove a serious difficulty. Of equal importance is the background, which might be of a light-green colour, which would reflect some light, and would at the same time enable the white feathers of the shuttlecock to be easily seen.

The North-East Coast Lighting Service Bureau

We understand that a number of useful lectures have recently been given under the auspices of the newly formed Lighting Service Bureau, with headquarters in Newcastle-on-Tyne. Lectures were recently given by Mr. E. S. Evans, on "Light as a Sales Force," to the Darlington Chamber of Trade (April 8th) and to the Ferryhill Chamber of Trade (April 14th).

In addition, a course of six lectures is being given to Girl Guides Associations on the following subjects:—"Lighting Fundamentals and Coloured Light" (Mr. E. S. Evans); "The History and Development of Wireless" (Mr. R. J. Oliver); "Lighting in the Home" (Miss A. Jackson); "Medical Electricity" (Dr. Christina Barrowman); "Electricity in the Home" (Miss Anna Holm); "Light in Industry and Commerce" (Mr. E. S. Evans).

Lectures of this kind should certainly help to impress the younger generation with a conviction of the value of proper lighting, and one is particularly interested to note this attempt to interest the girls, in whose hands the lighting of the homes of the future will largely rest.

Electrical Showrooms and Exhibitions

Reference has several times been made in this journal to the tendency of municipal electrical undertakings to install well-equipped showrooms, where lighting fittings are exhibited and demonstrations of their effects can be given. The imposing new showrooms at Hackney have been mentioned. On April 8th new showrooms of the Birkenhead Electricity Department were opened by the Mayor of this city. Here a variety of lighting fittings, as well as other electrical appliances, are on view. We understand that developments by other supply undertakings are in prospect.

Another item of interest was the exhibition of electrical appliances organized by the Corporation Electricity Committee in Keighley Municipal Hall.

A Clearing House for Information; its Value to Science and Industry and its Relation to the Technical Press

At a meeting of the Circle of Scientific, Technical and Trade Journalists, held at the Hall of the Institute of Journalists on April 19th, an interesting discussion on the above subject took place. Mr. L. Gaster (Hon. Secretary of the Circle) presided.

The introductory paper was read by Mr. J. G. Pearce, who is Chairman of the Association of Special Libraries and Information Bureaux ("A.S.L.I.B."), who emphasized the growing demand by the public for "fact-information," which coincided with a remarkable increase in the volume of information available, owing to recent advances in science and industry. Whilst many specialists and experts were willing to give information of a non-confidential character, provision was lacking whereby supply and demand could be equated.

It was mentioned that abroad very comprehensive schemes for the tabulation and indexing of all available information had been initiated. Such collections were admirable repositories for the future historian, but they were too complex for the ordinary seeker after information. In this country it was proposed to meet the need by setting up a clearing house dealing with all types of information concerning science, technology, and the humanities under the auspices of the Association of Special Libraries and Information Bureaux, which had recently been formed. The first function of this new body would be to prepare a Directory of sources of information in Great Britain, for which task the Carnegie United Kingdom Trustees had generously granted the sum of £2,000.

An interesting discussion ensued in which Mr. Hulme, Major Simnett, and others interested in the subject from the librarian's standpoint, took part, whilst Mr. A. C. Meyjes, Mr. S. Rentell, Mr. R. F. Knox and others emphasized its importance to the technical journalist. A letter was read from Mr. Bradford, Director of the Science Library, South Kensington, drawing attention to the very comprehensive series of scientific books and publications in this library, and insisting on the necessity for uniform and correct methods of indexing. He mentioned that the library also possessed indexes of important bibliographies abroad, and, in conclusion, suggested that a simple extension of its organization would enable the Science Library to serve as a general bureau of information.

In the discussion reference was also made to other libraries, including the Patent Office Library, where useful technical information was available, and there was a general recognition of the need for interlinking all these sources of information, which would be of great utility to the press. Any steps likely to render the contents of technical journals more widely known would be welcome.

A vote of thanks to Mr. Pearce for his paper was moved by Mr. L. Gaster, who spoke from personal knowledge of the importance of the work which the Association was undertaking, and the vote was carried with acclamation.

Electrical Association for Women

First Annual General Meeting, on Friday, May 7th

We are interested to note that the first Annual General Meeting of the Electrical Association for Women is to be held at the Criterion Restaurant (Piccadilly, London), on May 7th. Addresses have been promised by the Right Hon. Lieut.-Colonel Wilfred Ashley, M.P. (Minister of Transport), Miss Ellen Wilkinson, M.P., and Sir Hugo Hirst, Bart. The increasing interest being taken by women in engineering and illumination especially is being watched with interest, and no doubt there will be a useful record of work during the Association's first year of existence to present.

Daytime view of a London Machine Shop fitted with "Belvedere" Gas Lighting Pendants for use at night time.

Factory Lighting by Gas

IT is only within recent times that ample and efficient lighting of factories and workshops has become recognized as a very big factor in production and, therefore, a sound business proposition, as well as a humane provision. The realization of this important truth has followed the psychological study of the workers which has been deliberately undertaken by the more enlightened employers, because they saw that, to get the best work and the greatest output, it is essential that working conditions should be such that the workers are happy and contented. Clean, bright workshops, ample ventilation, good lighting, rest rooms, social clubs, and so on are all modern ideas put forward to this end.

In this present article we are concerned with the good lighting of factories and workshops, and, lest it should be thought that the proposals savour of "molly-coddling," may it be said at once that every one of them has been proved to be economically sound. Good lighting does not necessarily mean a blaze of light; in point of fact, too much light is often quite as bad as too little in its effect on the nerves and temper. By good lighting we mean such a scheme of illumination as would enable every operator to perform his or her task without eyestrain and the resultant headache and irritability, will permit movement about the building with perfect safety, and will provide a general atmosphere of brightness, especially overhead, so that a sense of depression is not induced.

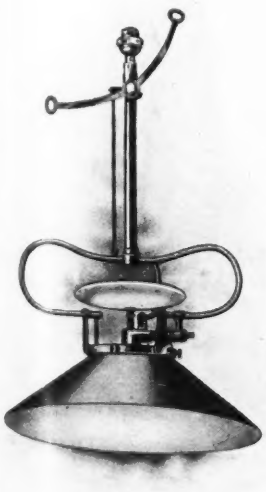


Fig. 2.

All of these conditions can be complied with easily by gas. In the first place, the clear, white light of an incandescent mantle is a close artificial equivalent to bright daylight. It does not try the eyes, because it is almost the same as the light to which they are naturally accustomed. Secondly, the intrinsic brilliancy of the incandescent mantle is low, owing to the comparatively large area which provides the light; consequently there is a greatly diminished tendency to glare —that great evil of artificial light which must be avoided in any efficient scheme. Another great advantage of gas for factory lighting is the moderate heat it imparts to the upper air, thereby assisting ventilation immensely, and also preventing the sudden falls of cold air which are inevitable without some form of upper heating, and which give rise to an unpleasant and irritating sensation of draught.

It is now proposed to deal with the various types of fittings suitable for factory and workshop lighting. Probably the most popular of all is the "Swanley" lamp, an illustration of which appears in Fig. 2. This lamp is of very sturdy make, and gives good and long service with very little attention; it is free from glassware, and is provided with a super-heated cluster of the small No. 2 size mantles, a very substantial gas-and-air regulator, a by-pass and an enamelled steel reflector shade. There are various sizes of this lamp, carrying from two to fifteen small mantles and giving from 160 to 1,500 candle-power. The "Swanley" is intended for the general lighting of large lofty factories, and should be used only where it can be

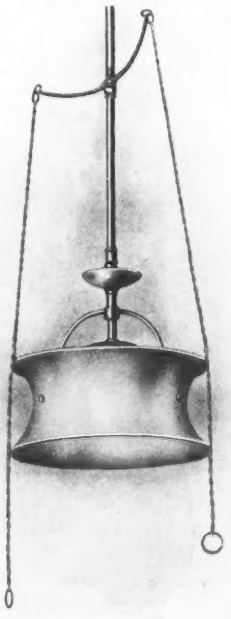


Fig. 3.

FIG. 4.

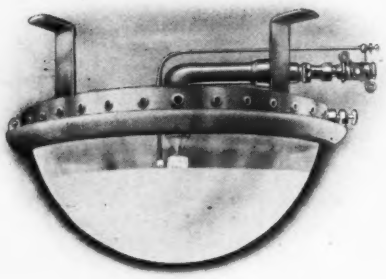


FIG. 5.

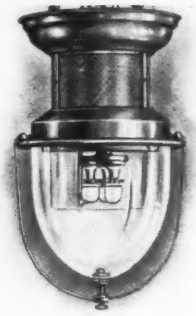


FIG. 6.

fixed at sufficient height to ensure that the mantles are above the normal range of vision of the workers.

For the general lighting of small or low workshops, the " Belvedere " pendant (see Fig. 3) has been specially designed. This is made on lines somewhat similar to the " Swanley," but has a fairly deep shade of a unique design which is very much more protective to the eyes and also is quite open at the top, thus allowing a certain amount of light to be given to the upper part of the workshop, by this means conveying the sense of overhead brightness and loftiness, which is so essential in such buildings.

General lighting should be provided in almost every case, but in addition to this, wherever fine work has to be done, it is necessary for each bench or machine to be lighted separately. With localized lighting it is more than ever essential to provide against glare. A fitting which sheds ample light on to the work without throwing any into the eyes of the worker is the " N. W." burner with deep shade, to be seen in Fig. 4. The " N. W. " burner, again, is very substantially constructed in heavy brass and cast aluminium; it has an excellent gas-and-air regulator, and with its one, two or three No. 2 size mantles on super-heater, and its specially designed deep shade, it is the ideal fitting for the lighting of single benches and machines.

The fittings referred to above are the types used most extensively for factory and workshop lighting; but there are many others for specific purposes in particular trades. In textile factories, flour mills, and other places where the air necessarily becomes laden with dust, the " Bradford " burner is used largely, its special feature being a fine wire gauze round the air chamber to prevent ingress of dust and a " stirrup " ejector which permits of the gas nipple being removed for cleaning without interfering in any way with the remainder of the burner. In factories in which inflammable gases are encountered, such as chemical works, garages, and so forth, the " Garage " lamp, with ventilation openings protected by " Davy " gauze (see Fig. 6) is used largely, and is, of course, perfectly safe for its purpose. In some factories where elaborate machinery is employed, in engine-rooms, etc., it is often desirable to provide a powerful light on the particular part of the plant which is the constant care of the engineers, and in such cases frequent use is made of the smaller sizes of the " Littleton " lamp (see Fig. 9), fitted with parabolic reflector to focus powerful light on the desired spot.

But factory lighting does not end with the provision of good illumination in the workshops. There are nearly always corridors and passages along which raw material and finished products have to be transported; and for these the " 1548 " back lamp, for fixing to the walls (see Fig. 7) and the " Corridor " ceiling light (Fig. 5) are to be recommended. For the yards, loading docks, and, in fact, any outdoor position, the " Littleton " or " Rochester " lamps are ideal (see Fig. 8 for example of the " Littleton " lamp).

A fact which is not always realized in connection with the lighting of factories by gas is the ease with which the whole of the lighting may be under the control of the foreman or someone in authority. A patent and thoroughly reliable distant control device which is operated without the running

FIG. 7.

FIG 8.

FIG. 9.

of any separate pipes permits any number of lights to be controlled by a single tap placed in any convenient position. In an ordinary machine shop, with foreman's office, for example, one tap could be fixed to operate the whole of the lighting of shop and office, if desired; but probably it would be more practical to install one control for the office, one for the general lighting of the shop, and one for the local lighting of each bay or row of machines, and possibly one for any lights which are used quite independently of the general lighting—for example, for one or two lights which would have to be turned on when the night watchman was paying his rounds. Such an arrangement is perfectly practicable, and is in use in quite a number of well-equipped modern factories.

Gas installations on the lines indicated in the foregoing notes comply in every detail with the regulations of the Home Office relating to factory lighting.

Summarized briefly, adequate, well-distributed and properly-shaded gas lighting in factories is essential in the interests of the workers' eyes and of their general welfare; it is absolutely reliable, it has very important ventilating advantages, it is controlled just as easily as any other form of lighting, and—what is most important in these days when keen competition at home and abroad necessitates continuous efforts to lower working expenses—it is very economical.

Light, Lighting and Vision

A LECTURE on the above subject was given by Mr. John Darch to the Incorporated Clerks of Works Association, at the Carpenters' Hall (London Wall) on February 16th.

The lecturer referred to the wonderful progress recently made in the production of light, but remarked that methods of using this light were frequently unscientific and ill-advised. Instances of "glare" (which the lecturer defined as "light in the wrong place") were common. After dealing briefly with the nature of radiation and the complexities of the human eye, Mr. Darch drew attention to the marvellous power of adaptation of the retina, which could deal with a range in brightness of about 800,000 to 1. But this process of adaptation required time, and sudden contrasts were objectionable. When a bright light was seen against a dark background the contrast might become "violent." Professor Weber, many years ago, had recommended that the contrast between the brightest and darkest objects in the field of vision should not exceed 100 to 1, whereas in much modern lighting contrasts more like 10,000 to 1 are not uncommon. The importance of contrast was illustrated by the lecturer by exhibiting a lamp shown in succession with backgrounds of white cloth and dark velvet.

Another section of the lecture illustrated the evolution of the eye by reference to daylight, the part played by the atmosphere in diminishing the light from the sun when near the horizon being pointed out. Effects of glare were illustrated by many slides showing conditions in factories, schools, hospitals etc.—the lecturer quoting Miss Florence Nightingale's observation that "the very first requirement in a hospital is that it should do the sick no harm." Reference was next made to the problem of the intensity of illumination required for reading and writing and various industrial processes. For most purposes an illumination of from 6 to 10 foot-candles would suffice, but in cases of very fine work, or in dealing with exceptionally dark material, higher illuminations might be needed. But *direction* of light was of equal importance—a point illustrated by pictures showing how badly placed lights may lead to cramped positions of the body of a school child, or may cause inconvenient direct reflection from polished and glazed surfaces.

The lecturer then proceeds to deal with the essential part that lighting plays in the proper display of art and architecture. The full effect of fine public buildings can only be revealed in the light for which they were designed, and that light is usually from above. The Ancient Greeks realized that it was on the lights and shadows that the effect of the glorious work depended, and it was much the same with Mediæval Gothic. Many fine modern buildings were used mainly in the evening; it was therefore chiefly by artificial light that they could be seen. Mr. Darch mentioned the dome-lighting of the new Port of London building as a natural and successful effect, but criticised the new lighting of St. Paul's Cathedral, remarking that a splendid opportunity of making use of its beautiful dome for lighting purposes has not been missed.

After dealing briefly with direct, indirect and semi-indirect lighting, the lecturer drew attention to the many different problems involved in the lighting of schools, libraries, factories, etc., alluding to the importance of good industrial lighting in relation to health and safety and remarking that "the health of the worker is the wealth of the employer." He believed that the 20th century would see as great an advance in the reasonable handling of light as the 19th century saw in its production.

Sheffield Illumination Society

A very interesting lecture was given to the members of the Sheffield Illumination Society by Mr. S. T. S. Musgrove, the Distribution Superintendent of the Sheffield Gas Company, in the Council Room at the Montgomery Hall, Sheffield, on the 15th inst., the subject being "The Distribution of Gas."

Mr. Musgrove explained in detail how a Gasholder was constructed, the method in which the lifts engage one with another, and these points were illustrated by a blackboard drawing. The lecturer then described very fully the Station Governors, Distribution System, Mains, Services, High Pressure Mains and Compressing Plant. Mr. Musgrove also referred to the Reducing Governors and District Governors. Wet and dry Gas Meters were exhibited and the members took advantage of an invitation from Mr. Musgrove to inspect these after the lecture. This proved very interesting, and further data given by the lecturer was much appreciated. A considerable number of lantern slides were shown which further illustrated the points explained in the lecture.

After the lecture there was an excellent discussion and many interesting points were dealt with. Mr. J. F. Colquhoun, who presided, thanked Mr. Musgrove for the trouble he had gone to in making the lecture so educative and enjoyable and said that judging from the discussion that had followed the lecture the members had had a very interesting evening.

Lighting Service Departments in the United States

We notice in *The Electrical World* another note emphasizing the growth of lighting service departments maintained by electric supply undertakings in the United States. The number of such departments is constantly growing. They vary in size from those using the part-time of one man, to others requiring the whole time of two dozen men. Recognizing that a lighting service department should be established upon a sound basis knowledge of lighting practice, the Illuminating Engineering Society (U.S.A.) recently invited a number of leading lighting service men to hold a meeting in connection with its annual convention in Detroit. The meeting was attended by 65 lighting service men, and proved very successful. Another recent step is the formation of a lighting service committee, which is to serve for the interchange of ideas, and has begun the preparation of a comprehensive "lighting service department manual."

(Continued from p. 105.)

consists partly of red and partly of green, its appearance when viewed in turn by red or green light respectively may be very different. This principle has been applied to the production of stage illusions,

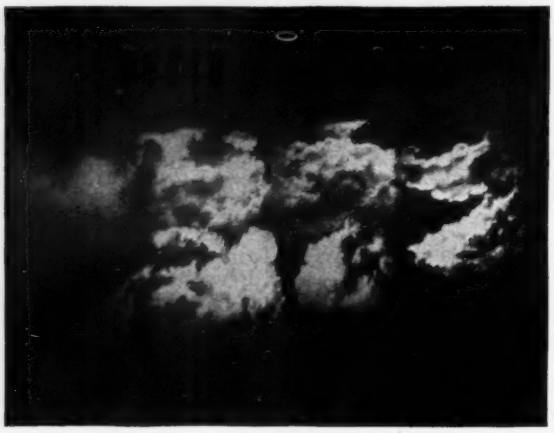


FIG. 4.—A Cloud Picture, showing bottom tier of horizon floods; the latter, of course, are not seen by patrons.

and by suitably relating the painted colours and the colour of the impinging light remarkable changes in the appearance of scenery may be produced. The idea has also been applied in order to bring about an apparent transformation in the clothing of dancers.

Another possibility, alluded to at a recent meeting of the Illuminating Engineering Society, is the projection of scenery and designs in varied colours as a substitute for painted canvas.

Conclusion.—In conclusion, it may be mentioned that there is a distinct tendency for kinema theatres to combine the exhibition of films with displays of a more or less theatrical character, and some of the latest theatres, especially in Germany, have accordingly been fitted with complete stage-lighting equipment. The cyclorama apparatus may prove a valuable auxiliary in kinema displays, provided sufficient depth of stage is allowed to give a proper perspective. At the recently opened Plaza Theatre in London a completely equipped stage, including the cyclorama, has been provided.

FIG. 5.—Another Cloud Picture. These clouds move across the screen, according to the movement of the cloud apparatus, in vertical and horizontal directions.

The stage lighting of the future will require the co-operation of all concerned—the producer, the scenic artist, and the stage-lighting expert. The services of the stage electrician also deserve recognition, as on his executive ability the success of lighting effects largely depends.

In conclusion, the author desires to express his indebtedness to the General Electric Co. Ltd. for the loan of apparatus, lantern slides, and illustrations for inclusion in this paper.

Discussion

Mr. L. G. APPLEBEE, in opening the discussion, congratulated Mr. Groom on his excellent paper, but he disagreed with the inference that might be drawn from his statement that stage lighting is apt to be treated in this country "as a necessary and unavoidable evil." As one interested in theatrical lighting, he (Mr. Applebee) did not think that we were behind the times. During his many years of theatrical experience he had seen some wonderful lighting effects, both in London and in provincial theatres. Considering only the period from the war onwards, many examples of good, efficient and spectacular lighting could be recalled. The lighting of the production of "The Garden of Allah" at Drury Lane caused quite a sensation, and Mr. Mather, the engineer, had inquiries from all parts of the world as to how certain effects were obtained. Similarly "The Old Vic" was regarded as a model of good lighting; Mr. Robert Atkins had been successful in producing some wonderful effects. The lighting of Miss Sybil Thorndike's productions was always carefully carried out. Amongst others, he might mention Sir Barry Jackson's Theatre in Birmingham, Mr. Fagan at the Court Theatre, Mr. Ben Rimo's production of "The Willow Tree," Mr. Basil Dan's productions and "The Blue Lagoon," Sir John Martin Harvey's productions, "Fata Morgana" at the Criterion and the Ambassadors, Mr. Matheson Lang's production of "Mr. Wu," Mr. Arthur Bourchier's production of "Treasure Island," The Everyman Theatre, Hampstead, and "The Battle of Zeebrugge" at the Admiralty Theatre, Wembley. Mr. Michael Wilson had carried out some very fine examples of lighting in the Royal College of Music productions.

The list might be considerably extended. But he mentioned this somewhat lengthy series to show that we were not asleep in this country. Moreover, the bulk of the installations quoted were carried out with apparatus made here.

Mr. Groom had referred to the extensive use of cyclorama effects abroad, but he (Mr. Applebee) thought that this form of apparatus was only adapted for use with plays of a certain type. They had used them in this country, for example, in "The Garden of Allah" at Drury Lane, "The Willow Tree" (the Globe), and in His Majesty's, the Duke of York, and at the Birmingham Repertory (where a permanent plaster one is in use), and also for the Zeebrugge production at Wembley. But for many plays—for instance, for a farce or comedy played in an interior—cyclorama effects were unnecessary.

It should also not be assumed that variety-stage lighting necessarily involved the concentration of light on the individual to the exclusion of everything else. Nowadays the variety theatre required as efficient an equipment as a theatre. In this connection Mr. Applebee mentioned a series of variety theatres which were equipped with the most modern apparatus (London Hippodrome, Metropolitan, South London, Palladium, Liverpool and Birmingham Empires, etc.).

Mr. Applebee disagreed with the suggestion that the liquid dimmer is dying out. Quite recently, at His Majesty's Theatre, the existing metallic dimmers were found inadequate, and certain ones had to be replaced by liquid dimmers, as they were set for a certain load. Before the metallic dimmer comes into universal use the problem of allowing for the effect of varying loads has to be overcome. The Royal College of Music has recently installed a switchboard by means of which it is possible to transfer a dimmer from circuit to circuit; but, even so, a certain number of liquid dimmers have to be used. The Old Vic is also working a combination of both, which he thought was nearer the ideal. During the past twelve months five theatres, to his knowledge, had installed liquid dimmers, owing to the varying loads with which they had to contend.

He agreed completely with Mr. Groom's remarks on the amount of space to be allotted in a theatre for switch and control gear. Early co-operation of the architect and the consulting engineer on this point is vital. Consultation between architects and consulting engineers at an early stage was equally necessary in connection

with footlights or floats, with a view to determining the position of such units with regard to the sight line of the front row of stalls. Most architects allowed one or two inches above the stage level at fire-curtain line—which was absurd if the efficiency of the flat was to be maintained.

Mr. Groom had mentioned the use of 100-watt lamps in the battens of one of their theatres. Such lamps were likewise being used for "The Student Prince" at His Majesty's, the lanterns being of the 17 "Sunray" pattern, having a glass reflector. The question of the risk of breakage of glass reflectors was sometimes raised. He might mention that in the London Hippodrome several hundreds have been in use for over four years, and to his personal knowledge there had never been a breakage, or even a case where reflectors had to be resilvered. He doubted whether existing metal reflectors would stand the heat of a gasfilled lamp for even one year with a continued reflecting power of 90 per cent. The above reflectors mentioned had been in use at the London Hippodrome for four years, and furnished results that would take a lot of beating with polished metal.

Great advances in the gasfilled lamp were still possible, but at present it was impossible to obtain a "pin-focus" and retain the full efficiency. Hence their use for projection effects was necessarily limited, as compared with an arc. Finally, Mr. Applebee mentioned the Zeebrugge production at Wembley as a recent example of cyclorama lighting. Everything in this show was done electrically.

Mr. Applebee concluded his remarks by demonstrating several optical effects, such as a "rough sea," a "fast-running sea," a "snowstorm," a "cloud" effect, and a representation of a fire showing huge flames which could be made 20 ft. in height. All the above were worked from a portable 30-ampere arc lantern, the whole apparatus being designed to allow of travelling from one theatre to another. In addition, several lanterns of British manufacture featuring the "Sunray" reflector were exhibited, together with lantern slides of several modern stage switchboards and regulators installed in various theatres.

Mr. Applebee expressed his appreciation of the courtesy of the Directors of the Strand Electric and Engineering Co. Ltd. in enabling him to exhibit this apparatus and show the various lantern slides.

Mr. J. S. DOW congratulated Mr. Groom on his paper and Mr. Applebee on the interesting demonstrations. The display of waves in motion was particularly lifelike. Mr. Groom had dealt mainly with implements of the stage, to which the cyclorama was a valuable addition during recent years. The idea of projecting luminous scenery mentioned by Mr. Groom had also great possibilities. Some of those present would recall the demonstration of the Mutochrome apparatus, with which such coloured patterns and designs could be reproduced, and Major Klein's description of its application. An important point was

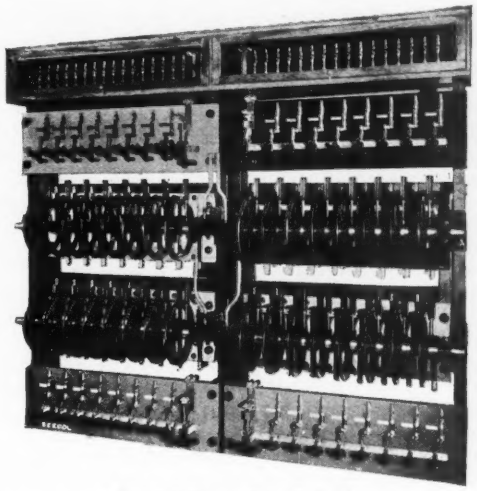
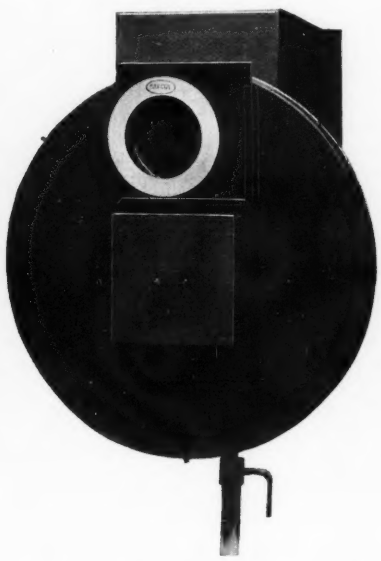


FIG. 2.—32-way "Seecol" Four-colour Switchboard, complete with 32 liquid dimmers.



FIGS. 1A and 1B.—"Seecol" Optical Effects Machine. By this apparatus such stage effects as clouds, rain, snow, rainbows, rough sea waves, water ripples, lightning, aurora borealis, smoke and flames, etc., are imitated. The apparatus has the advantage of being portable, and is therefore well suited for the use of theatrical touring companies. A 30-ampere hand-feed arc lantern is used.

FIG. 3.—Panorama Lantern, fitted with semi-circular "Sunray" reflector, and also provided with ground-glass diffusing screen and runners for gelatine colour frames. The angle of light is 180, and the lantern is specially constructed for lighting theatre cyclorama cloths. 100-watt gasfilled lamps are used.

Some of the Apparatus exhibited by Mr. L. G. Applebee

the gain in *contrast* by projection methods. In this respect there was the same distinction as between a lantern slide and a photographic print.

Mr. Dow recalled Mr. Fagan's able paper before the Society in 1919. Mr. Fagan was a strong believer in diffusion of light by indirect methods, and he (Mr. Dow) was inclined to think that much of the stage-lighting of to-day would be somewhat more pleasing if such methods could be applied, even though they occasioned some loss of light. When direct light from concentrating reflectors was used, considerable skill was often necessary to avoid unsightly shadows; sometimes when a series of colour units were applied one could see evidence of a number of coloured fringes, due to overlapping shadows.

It was often said that the highest compliment that could be paid to theatrical lighting was that it should itself be unobtrusive. He recalled the case of a celebrated critic who had been asked by the illuminating engineer to examine and report on the lighting. When questioned after the performance he confessed that " he had been so interested in the play that he had forgotten to think of the lighting." The illuminating engineer replied that this was the highest praise his lighting could receive. To many plays, in which the action was the dominant consideration, this conception of the functions of lighting doubtless applied. On the other hand, there were productions which endeavoured to introduce the audience into fairyland by means of an appeal to the eye, and here lighting might itself become an active agent, and spectacular lighting effects were not out of place.

Lighting effects might also be used to excite emotions and supplement the efforts of the actor. He recalled, in a discussion held by the Illuminating Engineering Society, in the United States, a reference to the grave-side scene in " Hamlet." Here a little humour is deliberately introduced in order to allow a little respite from the general gloomy atmosphere. It was found in one production that during this episode the audience could not be induced to abandon the sombre frame of mind and laugh, but, by subtly altering the lighting, a stimulus to the change of mental attitude was given and the desired effect produced.

Mr. Dow remarked that the use of spot-lighting was sometimes overdone. There were occasions when some object on the stage assumed a temporary importance, which might fitly be emphasized by special lighting. But it was surely inartistic when the leading actor was continually followed about by a beam of strong light. Apart from the impression received by the audience, the effect on the actors deserved consideration. The phrase " the glare of the footlights " had a literal basis, and he thought that, however hardened he might be, an actor might find difficulty in behaving quite naturally when subjected to the glare of a miniature searchlight. He believed that these considerations now received more weight in the production of kinema-films, where there had recently been a tendency towards the use of softer and more fully diffused lighting effects.

Mr. W. C. RAFFÉ wished to deal with the artistic side of the question. He had been greatly impressed by the intense desire to get naturalistic effects. He thought that it was incorrect to suppose that such effects were suitable for every kind of play. He had discussed the question after Mr. Fagan's paper in 1919 with his friend Mr. McDermott, and they had come to the conclusion that while a number of plays demanded naturalistic scenery setting and lighting throughout, the whole effect must be unified. The unnatural lighting of naturalistic scenery might produce a disunified effect.

What was called the St. Andrew's Cross was not wanted on the stage. There was something to be gained from gradation, notably in the case of dancers. He thought that colour shadows should be made use of instead of being got rid of. The late Sir Henry Irving had a very strong objection to the use of electric light in plays, and he and Miss Ellen Terry always insisted at the Lyceum on the use of gas because of the softer light that it gave. It must not be forgotten that " the play is the thing," and the artistic side of lighting should reinforce the intention of the author of the drama, so as to emphasize the emotional meaning of the play in conjunction with the spectacular effect. An interesting little book on that subject had recently been issued. Mr. Fagan and Mr. Dean had done excellent work in connection with what might be called the dramatic side of colour. Colour and lighting had been used at the Kingsway Theatre in a most successful way to accentuate the emotional part of scenes, and in no case was the light obtrusive. Daylight on the stage was seldom anything like real daylight. It was hardly ever a good imitation of direct sunlight, and certainly was never a good imitation of tropical sunlight. It must be remembered that there were three different colours of daylight, and not one only.

Miss HODGE suggested that flood-lighting should be used with discrimination. Otherwise one could imagine cushions and chair-covers and other objects of the same colour with the light thus introduced suddenly fading from view, and that might be rather awkward. With regard to plays, she could not agree with Mr. Dow that it was a disadvantage to have shadow effects. She could think of many in which the emotional parts might be greatly intensified by the introduction of shadows. In a play now running, called " The Three Sisters," a perfectly wonderful climax was reached by shadows thrown on the back of the stage, the players themselves not being seen. She could not help thinking that but for that effect the play would not be so remarkable as it was.

Mr. L. E. BUCKELL thought that what they had seen and heard that evening marked a new development, and that it might very well lead them further. The lighting of the stage with coloured light was by no means the least important aspect of the business of the illuminating engineer. Hitherto attention had been rather concentrated on the utility side of lighting, which, of course, it was very important to consider, but he thought that now they could go ahead with the romantic side. It seemed to him that the principles governing stage lighting, the use of projected light and coloured light, and the principles underlying the question of blending and contrasting applied to many other lighting problems besides. After all, window lighting was stage lighting in miniature. A very wide and very fascinating field lay open to the illuminating engineer. He hoped that the suggestions that had been made that evening would bear fruit, and that next year there would be papers on the application of colour lighting in many varied directions.

Mr. DIXON said that he came to learn, and was very satisfied, for he had learned a lot. It was rather surprising that difficulty had been found in getting architects to make proper room for stage lighting. One would have thought that lighting engineers had had time to educate architects with regard to what was required. The theatre electrician was no doubt a very good fellow, and often very competent, but naturally he had not always a sufficiently artistic temperament to interpret the wishes of producers. He could not help thinking that there was also an opening for a man who wanted scientific knowledge and artistic perception. Much useful information could be obtained from engineers concerned with stage lighting who, however, were usually men of action rather than men gifted with the art of exposition.

The CHAIRMAN (Mr. J. W. T. WALSH) said that he did not claim to have had any practical experience of colour flood-lighting in any form. Speaking from the purely theoretical point of view, one knew that any colour could be produced by the mixture in correct proportions of three suitably chosen colours. Why was it, therefore, that seven colours had been used in the apparatus that they had seen that evening, instead of three, or possibly four at the outside?

Apparently no attempt was made to equalize the luminosity of the colours used from time to time on the stage, and he wondered why that was. Sometimes when the colour was changed one got the impression that the whole stage had been suddenly plunged into darkness. Why was not lower luminosity compensated for by the use of a more powerful light behind the colour?

Mr. H. LESTER GROOM, in reply, said that Mr. Applebee had misinterpreted his paper if he thought that it cast a slur on British stage lighting. On the contrary, he agreed that many examples of excellent lighting could be mentioned, that many producers were fully alive to the value of lighting, that there were manufacturers in this country who had spared no pains in producing apparatus and keeping up to date. At the same time, he thought that it was very important to keep in touch with developments abroad. No country had a monopoly of brains, and there was much to be learned from the study of methods in other countries. The developments in Germany, to which he had alluded in his paper, were of very great interest. The scientific and artistic aspects were being made the subject of intense study. It was possible that the progress in Germany might be partly due to the fact that their stage was assisted by the State, and was free from some of the difficulties with which the British stage had to contend. He cordially agreed with the hope that apparatus manufactured in this country would ultimately be found to meet all requirements. And while, in certain optical matters, experts in Germany had made considerable advances, there was no reason why what was done there should not be equally well done here.

In regard to the cyclorama, he naturally agreed that it was not applicable in presenting all forms of plays, for instance, in scenes set exclusively in interiors, but it had such varied applications in connection with out-of-door scenes that it should form a part of general stage lighting equipment. In convenience of control, and in flexibility and variation of effects produced, it made possible results that could not be obtained with ordinary effect-projectors, though he agreed that the latter were most valuable for certain forms of work. The fact that the cyclorama apparatus could be operated from the main control room by one person, instead of its being necessary to use various implements in the hands of several operators, was a great advantage.

He had been pleased to note the insistence on the use of up-to-date apparatus, and there were many theatrical undertakings that had progressive ideas in this respect. At the same time, as Mr. Applebee must be well aware, there were still many theatres, especially in the provinces, where obsolete fittings dating back fifteen or even twenty years were still in use. In the United States there was, perhaps, a tendency to go to the other extreme, and he could quote instances of theatres with loads running up to several hundred kilowatts.

As regards the comparative merits of liquid dimmers and the metallic type, he agreed that the former were better for use on variable loads, such as, for instance, one would obtain on the stage dips, where apparatus of varying current-capacities is in constant use. But it should be borne in mind that a great deal of stage-lighting apparatus, e.g., footlights, battens, proscenium strip, and the cyclorama, involved definite fixed loads

The main difference between the two types was that with a properly designed metallic dimmer one could always repeat a desired effect exactly when the dimmer was set in a given position. This was not the case with liquid dimmers—a distinct disadvantage. Moreover, they required more attention as regards maintenance.

He agreed, however, that the best solution at present would probably consist of a combination of the two types —metallic dimmers for all fixed loads and a number of liquid dimmers for variable loads, such as those furnished by special effect-apparatus, etc.

He hoped that ultimately manufacturers would be able to make considerable further improvements in the gas-filled lamp. It was true, as Mr. Applebee said, that there were many services which arcs could serve better than gasfilled lamps. But the arc was something of a nuisance on the stage, as it required the continuous services of an operator to look after it, and it would be an advantage if gasfilled projector lamps could eventually be designed to replace them efficiently. The points raised in Mr. Dow's remarks could really be made the subject of a separate paper. He agreed that, generally speaking, lighting should be unobtrusive, though there were occasions when lighting effects formed the dominant thing on which the attention of the audience was concentrated. Mr. Raffé's comments also raised points somewhat beyond the scope of the paper. It was for the producers to determine how far naturalistic effects were desirable. The stage-lighting engineer could provide apparatus capable of furnishing any form of lighting. In regard to Miss Hodge's remarks, he agreed that colour-lighting should be used with discretion, especially in interiors. All those associated with the production of stage-lighting apparatus would welcome the co-operation of the architect, to which Mr. Dixon had referred. On their side, makers of apparatus were only too willing to give any information that he might desire when making provision for lighting.

Mr. Walsh had asked why seven colours were used in the cyclorama. In the first instance the three so-called primary colours, red, green, and blue, were provided, and the mixture of these would give white light, or a wide range of more or less saturated colours. There was a special reason for including the four additional shades of blue. In dealing with atmospheric and sky-effects blue was the dominant tint. The deep violet-blue, dark azure, light azure, and daylight-blue gave practically all the hues that could possibly be required. Hence it was a great convenience to have these colours ready, without its being necessary to mix other colours to get these particular tints. Mr. Walsh had also referred to the possibility of equalizing luminosity of colours on the stage. If red, blue, yellow, and white lights were used in equal numbers on the batten the substitution of, say, white lamps for blue lights would naturally give rise to a great increase in brilliancy. Absorption differed much for various colours. In order to equalize the lighting effect it would be necessary to increase the wattage of the lamp in circuit by an amount corresponding with the percentage absorption; thus assuming an absorption of, say, 90 per cent. for dark blue, a wattage of about ten times as great as that required for clear white lamps might be needed. However, under normal working conditions, this great increase in wattage was unnecessary, and in addition it would not be a practical proposition to design battens and floodlights on this basis. The whole question resolved itself mainly into one of expediency.

In conclusion, Mr. Groom expressed his appreciation of the reception of his paper, and added the hope that the discussion would prove useful both in arousing interest in stage lighting and in showing what could be done with the resources provided by the manufacturer of lighting appliances.

The CHAIRMAN (Mr. J. W. T. WALSH) proposed a very cordial vote of thanks to the lecturer for his interesting paper and demonstrations. Everyone would agree that the paper had been a most useful addition to the transactions of the Society.

Mr. L. GASTER, in seconding, mentioned that Mr. Groom had prepared the paper under difficulties, and had come to give them this instructive account of stage lighting at considerable personal inconvenience. He had shown that manufacturers were alive to the possibilities of stage lighting, and it was necessary that public opinion should be educated to demand proper methods. Managers of theatres did not always appreciate sufficiently the great importance of the proper lighting of the stage. He recalled that, in his well-known paper given before the Society in 1919, Mr. Fagan had placed lighting *third* in the list of essentials, the first being the play (" the play's the thing "), and the second the acting. Scenery, costumes, etc., came after the lighting, for without proper illumination they could not make any effective contribution to the general effect.

A vote of thanks to Mr. Groom having been carried with acclamation, Mr. Gaster also proposed a vote of thanks to the E.L.M.A. Lighting Service Bureau for their hospitality, remarking that the meeting had aptly illustrated the great advantages of their facilities for demonstrations and assistance in arranging exhibits. A vote of thanks to Mr. Walsh for presiding terminated the proceedings, after which it was announced that the next meeting, to be held at the end of April, would be devoted to a discussion on " School Lighting," to be opened by Dr. James Kerr.

British Standard Glossary of Terms used in Illumination and Photometry *

(Discussed at the Meeting of the Illuminating Engineering Society held on February 25th, 1926.)

EXPLANATION OF TYPE USED.

The preferred term, *i.e.*, the term recommended for general use, is shown in heavy capitals, thus ... ... **LUMINOUS INTENSITY.**

Synonyms of the term are shown in light capitals, thus ... ... CANDLE-POWER.

Abbreviations are shown in italics, thus ... *b.d.* and *M.S.C.P.*

These terms and definitions have been approved by the National Illumination Committee of Great Britain and are in accordance with the decisions of the International Illumination Commission, as far as such decisions are applicable.

TERM.	DEFINITION.
LUMINOUS FLUX.	The rate of passage of radiant energy evaluated by reference to the luminous sensation produced thereby. Symbol *F*.
LUMEN.	A unit of luminous flux. It is equal to the flux emitted in unit solid angle by a uniform point source of one candle.
LUMINOUS INTENSITY. CANDLE-POWER.	The luminous flux per unit solid angle, emitted by a point source in a given direction. Symbol *I*.
CANDLE-POWER.	Luminous intensity expressed in candles.
MEAN SPHERICAL CANDLE-POWER. *M.S.C.P.*	The average value of the candle-power of a luminous source in all directions. It is numerically equal to the total luminous flux in lumens divided by 4π.
MEAN ZONAL CANDLE-POWER.	The average value of the candle-power in a given zone, the angular limits of the zone being stated.
MEAN HEMISPHERICAL CANDLE-POWER, UPPER OR LOWER.	The average value of the candle-power in the upper or lower hemisphere.
MEAN HORIZONTAL CANDLE-POWER.	The average value of the candle-power of a luminous source in all directions in a plane through the centre of the source and perpendicular to its axis.
CANDLE. INTERNATIONAL CANDLE.	A unit of luminous intensity arrived at by common agreement between the National Physical Laboratory of Great Britain, the Laboratoire Central de l'Electricité of France, and the Bureau of Standards of the United States of America.
BOUGIE DECIMALE. *b.d.*	The legal unit of luminous intensity in France defined as one-twentieth of the luminous intensity, viewed normally, of a square cm. of molten platinum at the temperature of solidification. This unit has a luminous intensity of one candle.
STANDARD SPERM CANDLE. PARLIAMENTARY CANDLE.	An obsolete standard of luminous intensity consisting of a sperm candle weighing $\frac{1}{6}$th of a pound, and burning 120 grains per hour.
VERNON-HARCOURT PENTANE LAMP. PENTANE LAMP.	A wickless lamp burning pentane vapour and used as a standard of luminous intensity. As usually constructed, its luminous intensity under specified conditions of atmospheric pressure and humidity is 10 candles.
CARCEL LAMP.	A fine lamp burning colza oil. Its luminous intensity under specified conditions is 9·6 candles. It is now little used.
HEFNER LAMP.	A flame lamp burning amyl-acetate. Its luminous intensity, under specified conditions of atmospheric pressure and humidity, is the official unit in Germany. This unit is known as the **HEFNER CANDLE** and is taken as being equivalent to 0·9 (International) candles.
REDUCTION FACTOR. *Ab. for Spherical Reduction Factor*	Of a luminous source. The ratio of the mean spherical to the mean horizontal candle-power of the source.
ILLUMINATION.	The luminous flux reaching a surface per unit area. Symbol *E*.
LUX. METER-CANDLE.	A unit of illumination. It is the illumination produced on the surface of a sphere having a radius of one metre, by a uniform point source of one candle situated at its centre. It corresponds to a flux density of one lumen per square metre. One lux equals 0·093 foot-candles.
FOOT-CANDLE. CANDLE-FOOT (*deprecated*).	A unit of illumination. It is the illumination produced on the surface of a sphere having a radius of one foot, by a uniform point source of one candle situated at its centre. It corresponds to a flux density of one lumen per square foot. One foot-candle equals 10·764 lux.
PHOT.	A unit of illumination which is little used. It corresponds to a flux of one lumen per square centimetre. 1 phot = 10,000 lux.
BRIGHTNESS. INTRINSIC BRILLIANCY. SURFACE BRIGHTNESS.	Of a surface. The quotient of the luminous intensity in a given direction by the area of the surface projected on to a plane perpendicular to that direction. Symbol *B*.
LAMBERT, *U.S.A.*	A unit of brightness. The brightness of a perfectly diffusing surface emitting or reflecting one lumen per square centimetre. For most purposes the **MILLI-LAMBERT** (0·001 lambert) is of more convenient magnitude. One lambert equals $\frac{1}{\pi}$ (*i.e.* 0·318) candles per square centimetre.
VISIBILITY FACTOR.	The ratio of the luminous flux, of given wave length, to the energy flux. Symbol *K*.
EFFICIENCY.	Of a luminous source. The ratio of the total luminous flux emitted to the total power consumed. In the case of an electric lamp it is expressed in lumens per watt. In the case of a source depending on combustion it may be expressed in lumens per thermal unit per unit of time.
REFLECTION FACTOR. COEFFICIENT OF REFLECTION.	The ratio of the reflected luminous flux to the incident luminous flux. Symbol *p*. The factor may refer to the luminous flux specularly reflected as from a polished surface (**SPECULAR REFLECTION FACTOR**) or to that diffusely reflected (**DIFFUSE REFLECTION FACTOR**) or to the total luminous flux reflected (**TOTAL REFLECTION FACTOR**)

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TERM	DEFINITION.
ABSORPTION FACTOR. COEFFICIENT OF ABSORPTION.	The ratio of the luminous flux absorbed to the incident luminous flux. Symbol *a*.
TRANSMISSION FACTOR COEFFICIENT OF TRANSMISSION.	The ratio of the luminous flux transmitted to the incident luminous flux. Symbol τ.
LIFE TEST.	Of a luminous source. A continous running test for a stated period (usually 1,000 hours) during which measurements of candle-power and consumption are made at intervals.
PHOTOMETER.	A piece of apparatus for the measurement of luminous intensity, luminous flux illumination or brightness by comparison with a standard.
PHOTOMETER HEAD.	That portion of a photometer in which the photometric comparison is effected.
PHOTOMETRIC INTEGRATOR.	A piece of apparatus enabling the total luminous flux emitted by a light source to be determined at a single measurement by means of a photometer. The integrator usually takes the form of a spherical or cubical enclosure, the interior surface being white.
INTEGRATING PHOTOMETER.	A piece of apparatus consisting of a photometric integrator combined with a photometer.
PRIMARY LUMINOUS STANDARD.	A recognized standard of luminous intensity reproducible from a specification.
STANDARD LAMP. SECONDARY STANDARD LAMP.	A lamp the luminous intensity of which is accurately known in terms of the National Standards.
WORKING STANDARD LAMP. STANDARD LAMP.	A lamp the luminous intensity of which is known with sufficient accuracy for industrial purposes.
COMPARISON LAMP.	A lamp of constant but not necessarily known luminous intensity with which a standard lamp and the lamp under test are successively compared by means of a photometer.
TEST SURFACE.	In photometry. A prepared surface which is illuminated by the luminous source or sources under test.
COMPARISON SURFACE.	In photometry. A prepared surface which is illuminated by the standard or comparison lamp.
REDUCING SCREEN.	In photometry. A transparent screen serving to transmit a pre-determined fraction of the luminous flux reaching it.
REDUCING SURFACE.	In photometry. A prepared surface serving to reflect a pre-determined fraction of the luminous flux reaching it.
WINDOW EFFICIENCY RATIO. DAYLIGHT FACTOR.	The ratio of the illumination measured on a horizontal plane at a given point inside a building, to that outside the building and due to an unobstructed hemisphere of sky, the two being measured simultaneously.
SILL RATIO.	The ratio of the illumination measured on a horizontal plane at a given point inside a building, to that on the window-sill outside, assuming an unobstructed quarter sphere of sky, the two being measured simultaneously.
VARIATION FACTOR.	Of illumination over a given plane. The ratio of the maximum illumination to the average illumination over that plane.
VARIATION RANGE.	Of illumination over a given plane. The ratio of the maximum illumination to the minimum illumination over that plane.
DIRECT LIGHTING.	A system of lighting in which the greater part of the luminous flux, after leaving the fitting, passes directly towards the area to be illuminated.
INDIRECT LIGHTING.	A system of lighting in which the greater part of the luminous flux reaches the area to be illuminated only after reflection from a ceiling or other object external to the fitting.
SEMI-INDIRECT LIGHTING.	A system of lighting which combines the features of Direct and Indirect Lighting, the latter predominating.
DIFFUSED LIGHTING.	A system of lighting in which the luminous flux, after passing through a diffusion medium, reaches the area to be illuminated, in part directly and in part indirectly.
FLOOD LIGHTING.	A system of lighting for the general illumination of a large object to a comparatively uniform brightness by means of a beam or beams projected from a distance.
SPOT LIGHTING.	A system of lighting for the localized illumination of an object or part of an object to a brightness considerably greater than that of its surroundings, by means of a beam or beams of light projected from a distance.
ANGLE OF CUT-OFF.	Of a fitting, shade or reflector. The largest angle below the horizontal at which the light source is invisible when viewed from a point outside the reflector.
DAYLIGHT LAMP.	A lamp giving light of such a spectral distribution that objects illuminated by it appear to be of the same colour as when illuminated by daylight.

NOTE.—The terms contained in this Glossary are included in Section 8 of the British Standard Glossary of Terms used in Electrical Engineering (B.E.S.A. Publication No. 205, to be issued shortly).

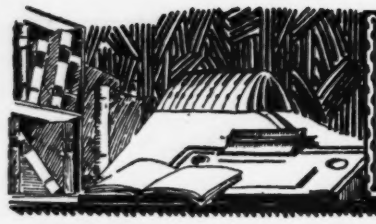
British Engineering Standards Association

Standardization in the Collieries. Extract from Report of the Royal Commission on the Coal Industry, 1925.—The Mining Association, with the British Engineering Standards Association, has recently set out to standardize colliery plant and equipment, and the work is proceeding through committees of those concerned with the manufacture and use of such plant. It is, perhaps, the most important general inquiry in which the industry has in recent times been engaged, and in view of the multifarious types of plant and equipment now used at different collieries for similar purposes, it may be expected to yield valuable gains in efficiency and economy.—C.B. (OC) 291.

Revision of B.E.S.A. Electric Cable Specification.—A revised edition of the B.E.S.A. Publication No. 7—1926, British Standard Specification for Insulated Annealed Copper Conductors for Electric Power and Light, has recently been issued by the British Engineering Standards Association.

Few changes were found necessary in this revision, as is to be expected in a work of this character, although those made are of importance. One extra standard size (0·85 sq. in.) has been added to the list of stranded cables. Tables have been included to cover the thicknesses of vulcanized bitumen insulated and sheathed cables. A full list of definitions relating to conductors and cables has also been included.

Copies of this revised Specification may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1, price 1s. 3d. each, post free.



REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

MODERN SUNLIGHT, *Vol.* 1, *No.* 1, *March*, 1926. (*Published by The Sunlight Bureau, Oswaldestre House, Norfolk Street, London, W.C.2. Annual subscription*, £1 1*s.*)

This new journal is devoted to the consideration of uses of sunlight and ultra-violet light, and smoke abatement in the interests of health. The first issue contains a great variety of articles, showing the great interest which treatment by natural and artificial sunlight is now arousing. In the editorial notes reference is made to the question whether such treatment should be under medical control. We gather that this journal is independent in scope, and is not directed by the medical profession. Nevertheless it is agreed that in the case of powerful ultra-violet apparatus caution is highly necessary. Mr. L. T. M. Gray, of King's College, in an introductory article, emphasizes the importance of exact knowledge of the quality and intensity of radiation used, and other authors, whilst confirming the value of light-treatment in various diseases, likewise discuss the determination of "dosage." A number of illustrated accounts of methods of applying artificial daylight treatment at hospitals and spas are included; yet developments abroad appear to be on a greater scale, as is illustrated by the account of progress in Denmark, Switzerland and Italy, where, it is stated, there is practically no great or minor city which has not some form of institution for preventive or curative treatment of children through sunlight. This country is less fortunate than Italy in the matter of sunlight—all the more reason, therefore, to concentrate attention on the elimination of the "smoke blanket," by which even such sunlight as does reach us is impeded.

The journal contains many sidelights on radiation and ultra-violet light. The chart showing the complete range of electro-magnetic rays shown by the British Empire Exhibition Committee of the Royal Society is reproduced, and a brief reference is made to the new rays, even shorter and more powerful than those of radium, discovered by Professor R. A. Millikan, of Pasadena, California. Other articles deal with Sunlight at the Zoo, the Applications of Fused Silica, and the Vitalizing Influence of Ultra-Violet Rays on Foodstuffs. Incidentally, some other uses of ultra-violet light are mentioned; for instance, in testing the fastness of dyes and the weathering of paints and varnishes, and for the manufacture of patent leather—for which purpose, it is stated, one firm alone in Germany is using 1,500 quartz lamps.

ADVERTISEMENT LIGHTING (*Werbewirksame Licht-Reklame*), *by Dr. Gerhard Schmidt* (*Union Deutsche Verlagsgesellschaft, Zweigniederlassung, Berlin, S.W.*19. 1925 *pp.* 48; *figs.* 37; *Mk.* 1,80).

In this little book the author sets out to give a general idea of the use of light for advertisement and spectacular display. In the introductory sections a summary of the objects of illuminated signs etc. is given, and a warning is conveyed that before any effect of this kind is initiated the police regulations should be carefully studied! The first devices shown are small signs for use in show-windows, some displaying lettering, others colour; amongst these the now familiar small projector using a special gasfilled lamp is mentioned. Examples of methods of illuminating the names of shops are next given after which the various forms of letter-signs are dealt with. Amongst tubular lights the neon tube is of chief interest. By small additions of mercury and other devices the ordinary orange colour may be modified; blue, green, yellow, and even white light can be obtained. Examples of the convenience with which script and patterns can be traced in such tubing are shown. The low current consumption is an inducement; 25 cms. letters only require 15-20 watts, 70 cms. letters only 80-100 watts. Finally a number of pictures of spectacular and exhibition lighting are shown. The book is very fully illustrated and is interesting, both in giving a review of illuminated signs and advertisement illumination, and also in showing the nature of the effects that are customary abroad.

THE YEAR BOOK OF THE SCIENTIFIC AND LEARNED SOCIETIES, 1925. (*Chas. Griffin & Co. Ltd., London; pp.* 407; 15*s. net.*)

This useful publication has been considerably extended during recent years, and now contains over 400 pages. It should continue to prove of considerable value to scientific and technical men, journalists and others, for it gives not only the names of officers and addresses of learned and scientific societies, but, in almost all cases, a record of papers presented during the past year. The items are tabulated and indexed, so that anyone can readily look up particulars of the leading bodies concerned with subjects in which he is interested. The compilation of this data must have involved a considerable amount of work, but the result is a valuable contribution to scientific and technical information. Incidentally the expansion of the volume gives an encouraging indication of the continual growth of work of this kind.

PRINCIPLES OF ELECTRIC LIGHTING, *by Professor M. Zelentsoff.* (*Couboutsch, Leningrad*, 1925; 432 xvi *pp.*)

Professor Zelentsoff, in this book (in Russian), deals with generation of visible energy and indoor illumination. We are given to understand that another book, which is to be a companion volume to the present one, dealing with outdoor illumination and certain special lighting problems, is to be published shortly.

After a preliminary chapter on the eye and its functions, the author deals with radiant energy units, photometers and photometry. The various electric illuminants are next treated: Arc lamps, incandescent lamps (the carbon-filament vacuum-type lamp, the Nernst lamp, and the tungsten drawn-wire vacuum-type lamp), tungsten gasfilled lamps, the properties of tungsten-filament lamps, the mercury arc, gaseous-discharge lamps (the Moore tube and the neon glow lamps). A section is devoted to general problems of illuminating engineering and principles of indoor illumination. Other chapters deal with brightness and adaptation; the illumination of surface and visibility; various systems of indoor illumination; lighting units; methods of calculation of light distribution for indoor illumination; the economic importance of correct indoor illumination.

Information from French, German, British and United States publications has been drawn upon freely. The German school evidently, and in view of geographical and economic circumstances, not unnaturally, dominates over the others. References made to Russian investigators indicate that there is evidently much which the scientists of that country have been able to accomplish during recent years, in spite of overwhelming difficulties.

The author has endeavoured to make his book both theoretically sound and practically useful. He has, in fact, succeeded in presenting the reader with much valuable matter, some of the tabulated information being particularly useful. On the other hand, there are some omissions. Thus, little or no reference is made to colour problems, the relation between luminosity and wavelength of light, and the use of the spectro-photometer. Similarly, whilst thermal radiation is fully considered, other forms of luminescence are almost ignored. In the chapter on photometers various German instruments are described, but the classical Jolly and Trotter photometers are likewise overlooked; also the more recent selenium and other photo-electric cells. One would also like to see a more adequate discussion of the accuracy of photometry.

Nevertheless, although some defects must be noted, much of the matter in the book may be commended. The chapters on brightness and adaptation and on illumination and visibility, for example, give real pleasure, and the exposition of the vital importance of correct methods of lighting in the first and final chapters deserves wide circulation. It is also encouraging to find this subject being the subject of study in Russia, where, as already noted, the difficulties in keeping abreast of developments in other countries have hitherto within recent years been very considerable.

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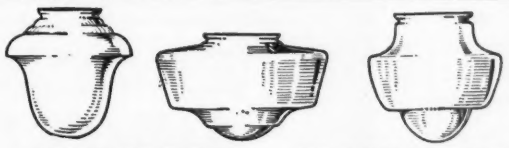

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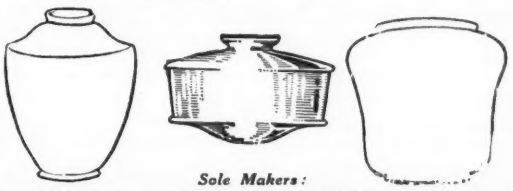

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TRADE NOTES & ANNOUNCEMENTS

FLOOD-LIGHTING OF CANADA HOUSE.

In our last issue we referred to the flood-lighting of Bush House, Kingsway. The accompanying illustration shows another attractive installation, the illumination of the exterior of Canada House, Trafalgar Square, London. The lighting is effected with G.E.C. 500-watt Osram gasfilled lamps. Buildings of this class lend themselves well to flood-lighting, and it is interesting to find this treatment being applied to imposing buildings, including those associated with Government Departments. The lighting up of such exteriors at night is also an asset in relation to public lighting, as it promotes diffusion of light and helps to relieve the sombreness of surroundings, which is apt to prove such a drawback in the illumination of our streets.

MESSRS. SIEMENS AND ENGLISH ELECTRIC LAMP CO. LTD.—CHANGES IN DIRECTORSHIP.

It may be recalled that Dr. Henry B. Wright was recently appointed Managing Director of Siemens Bros. & Co. Ltd. We are now informed that Dr. Wright, who has been a Director of Messrs. Siemens and English Electric Lamp Co. Ltd. since January 1st, 1923, has been appointed Managing Director of this Company. Mr. S. H. Callow, the Sales Manager of the Company, has now been appointed a Director.

THE ELECTRICAL ASSOCIATION FOR WOMEN.

Visit to Demonstration Rooms of Holophane Ltd.

On Friday, March 26th, the members of the above Association paid a visit to the demonstration rooms and laboratories of Holophane Ltd., at the invitation of that Company. The members turned up in good force under the able conductorship of Miss C. Haslett, and followed with great interest the short review on the scientific progress in illuminating Engineering which was given by Mr. L. M. Tye.

In the demonstrations which followed great interest was aroused by the films shown illustrative of show-window and interior lighting, covering all the field from public buildings, offices, domestic and industrial applications. Considerable interest was taken in the special colour demonstrations of cinema and electric-lighting appliances, and also in the working of the photometric instruments shown in the laboratory.

At the conclusion, a hearty vote of thanks was passed to the Directors of Holophane Ltd. for having afforded them the opportunity of seeing the demonstration rooms and laboratories and hearing this review of progress in illuminating engineering. The hope was expressed that an opportunity for another visit would be provided at a later period.

In addition to the members of the above Association, there were also present Mr. L. Gaster, the Hon. Secretary of the Illuminating Engineering Society, and Mr. Loveday, representing the British Electrical Development Association.

CONTRACTS CLOSED.

Messrs. Siemens & English Electric Lamp Co., Ltd.:

Metropolitan Water Board; tender accepted for the supply of Siemens Gasfilled Lamps during the ensuing 12 months.

Leeds Corporation Tramways Department; contract for supplying Siemens Traction Lamps for Car Lighting during the ensuing 12 months.

Metro-Vick Supplies Ltd.:

London, Midland and Scottish Railway Co.; for "Cosmos" Vacuum Train Lamps.

The Admiralty; for "Cosmos" Gasfilled Ordinary Lamps for H.M. ships.

An Imposing View of Canada House, showing Flood-lighting.

SIEMENS "SILVARAY" GLASSWARE.

A new list (No. 99) has been issued by Messrs. Siemens and English Electric Lamp Co. Ltd. dealing with "Silvaray" One-piece Glassware Fittings. These enclosing diffusing units are made in a variety of types. Mounted on chains, they are proving very popular for office and general lighting, whilst the form capable of being mounted direct on the ceiling forms a very useful fitting for kitchens, or in other rooms where overhead space is limited or it is desired to have lamps well out of the way of movements of people below.

NEW BIRMINGHAM OFFICES OF THE BRITISH THOMSON-HOUSTON CO. LTD.

Having outgrown their present establishment in Paradise Street, Birmingham, owing to continual expansion of business, the British Thomson-Houston Co. Ltd. have acquired commodious new premises in a central position in the City.

From March 22nd onwards the new address has been: 10 and 11, Snow Hill, Birmingham (Telephone No., Central 8301 (six lines); Telegraphic Address, "Asteroidal, Birmingham"). Reconstruction of a portion of the premises is still in progress, and when completed will provide up-to-date showrooms in which will be displayed an extensive selection of B.T.-H. electric-light fittings for industrial and general purposes; also a full line of heating and domestic electric appliances and the complete range of B.T.-H. wireless appliances. All communications should be sent to the new address.

GAS LIGHTING AT HOME AND ABROAD.

Under the above title, Messrs. Wm. Sugg & Co. Ltd. are issuing an attractive series of illustrations of gas-lighting installations, drawn from many parts of the world. Some of those in the first section, dealing with public lighting, are familiar, such as the views of Parliament Square and Buckingham Palace. But there are many others relating to distant parts of the world, such as Norway, Singapore and Pernambuco. In some cases photographs are taken by artificial light, in others by daylight, and there are also instances of the two side by side. Of these, two of the most charming are the pair of pictures representing Magdalen Bridge, Oxford, the night view showing the tower silhouetted against a sunset being extremely picturesque. The latter section of the book deals with parade and promenade lighting, some illustrations of which were reproduced last year in this journal.

EFFECTS OF "BLUE" AND YELLOW LIGHT.

Sir,—I have only this morning had the chance of reading the summary of the discussion at the last meeting of the Illuminating Engineering Society on the subject of coal-mine lighting. I was particularly interested in the remarks of Mr. Dow, who appears to offer a possible solution of the conflicting data in regard to the effect of coloured light.

In one respect, however, I do not quite agree with his theory. Whilst this is probably correct in regard to *actual "blue"* light, I know for a fact that the R.E. Board, in their experiments on a suitable screen for the control hole in arch searchlights, have decided on the use of unfrosted Restlight glass as giving clear definition without glare of any kind. This is due to the fact that though the *screen* is blue—or appears blue—the light that passes through is *white* with a "bump" of energy in the yellow-green range, and a band of non-luminous red to give warmth.

I raise this point in order to show that, notwithstanding the evidence adduced by Mr. Dow, white light, similar to daylight, may enable the effort of visual accommodation to be considerably reduced, as compared with ordinary artificial light, which, in comparison, appears to be relatively yellow in tint.

Yours, etc.,

E. J. HALSTED HANBY.

Sir,—The inconsistency referred to by Capt. Halsted Hanby seems capable of explanation.

My remarks were intended to apply mainly to the dark-adapted eye of the miner, working amidst dark surroundings, and to suggest a possible explanation of his preference for yellow light. The case of vision through the control window of a searchlight is materially different. The illumination is high, and we are here concerned with relatively near vision. Consideration of the effects of want of achromatism of the eye suggests that in the case of near vision a light that was, on the whole, tending to blue might give better definition than a yellow light; on the other hand, for distant vision, one would expect the contrary to be the case—and this has led to experiments with yellow searchlight beams in the belief that the distant objects illuminated by them appear somewhat sharper than with a white beam.

Capt. Halsted Hanby has sent me a diagram of the energy distribution of the Restlight glass, which certainly shows a pronounced hump in the yellow-green. The effect of such a "hump" on the ease of accommodation of the eye and the clearness of definition offers interesting ground for experiment. It is also a somewhat remarkable circumstance that although the curve exhibits this hump, in contrast with the continuous sweep of the corresponding curve for an ordinary gasfilled lamp, the aggregate effect is a light which approaches daylight more closely in colour.

Yours, etc.,

J. S. DOW.

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IT receives the assistance of contributors who are leading experts on illumination in this country and abroad. Foreign Notes and News will be a speciality, and correspondents have been appointed in all the chief cities of the world.

THE Journal contains *first-hand and authoritative information on all aspects of lighting;* it has also been improved and extended by the inclusion of a *Popular and Trade Section* containing special articles of interest to contractors, gas and electric supply companies, Government Departments and members of the Public.

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Good Lighting is of interest to everyone. The Journal is read by engineers, architects, medical men, factory inspectors, managers of factories, educational authorities, public lighting authorities, and large users of light of all kinds.

BESIDES being issued to all members of the Illuminating Engineering Society, the Journal has an independent circulation amongst people interested in lighting in all parts of the world. The new and extended form of the Journal should result in a continual and rapid increase in circulation.

Every reader of THE ILLUMINATING ENGINEER, the Journal of GOOD LIGHTING, *is interested in illumination, and is a possible purchaser of lamps and lighting appliances. Gas and Electricity Supply Undertakings likewise benefit by the movement for Better Lighting, with which the Journal is associated, and which stimulates the demand for all illuminants.*

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The Society preserves an impartial platform for the discussion of all illuminants, and invites the co-operation both of experts on illumination and users of light; it includes amongst its members manufacturers, representatives of gas and electric supply companies, architects, medical men, factory inspectors, municipal officers, and many others interested in the use of light in the service of mankind.

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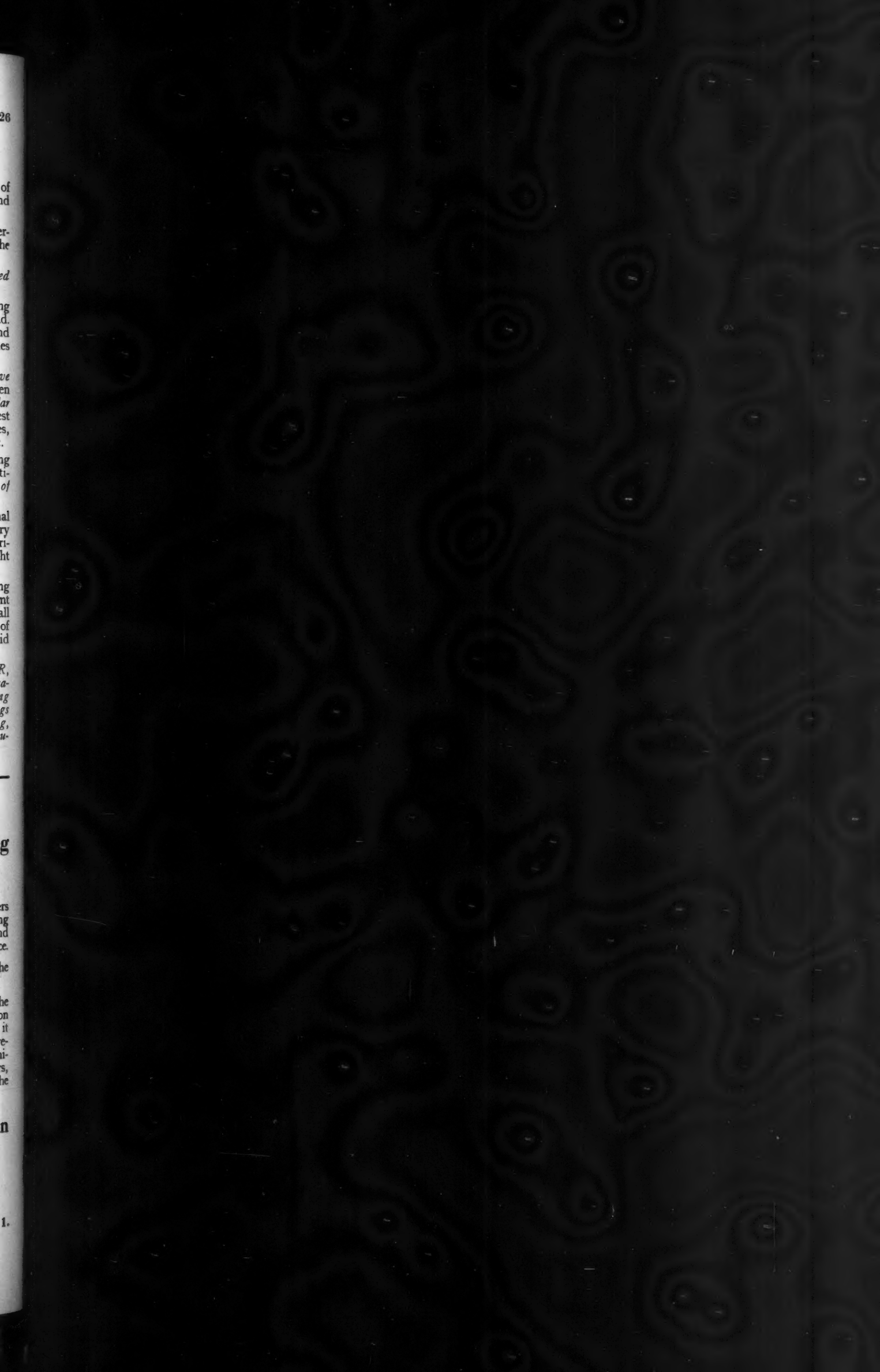
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